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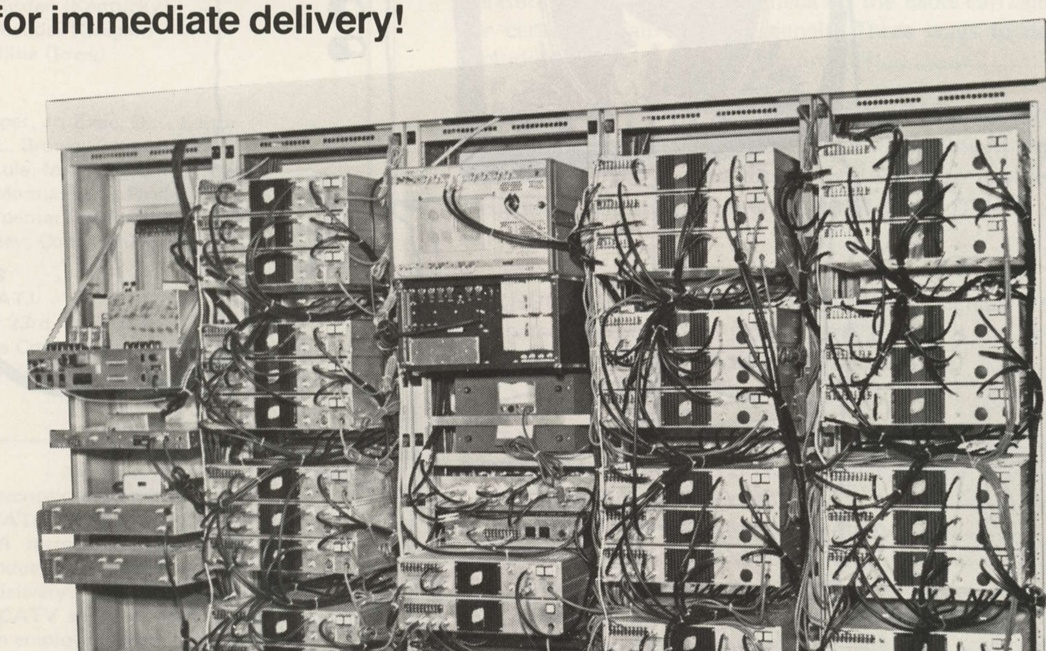

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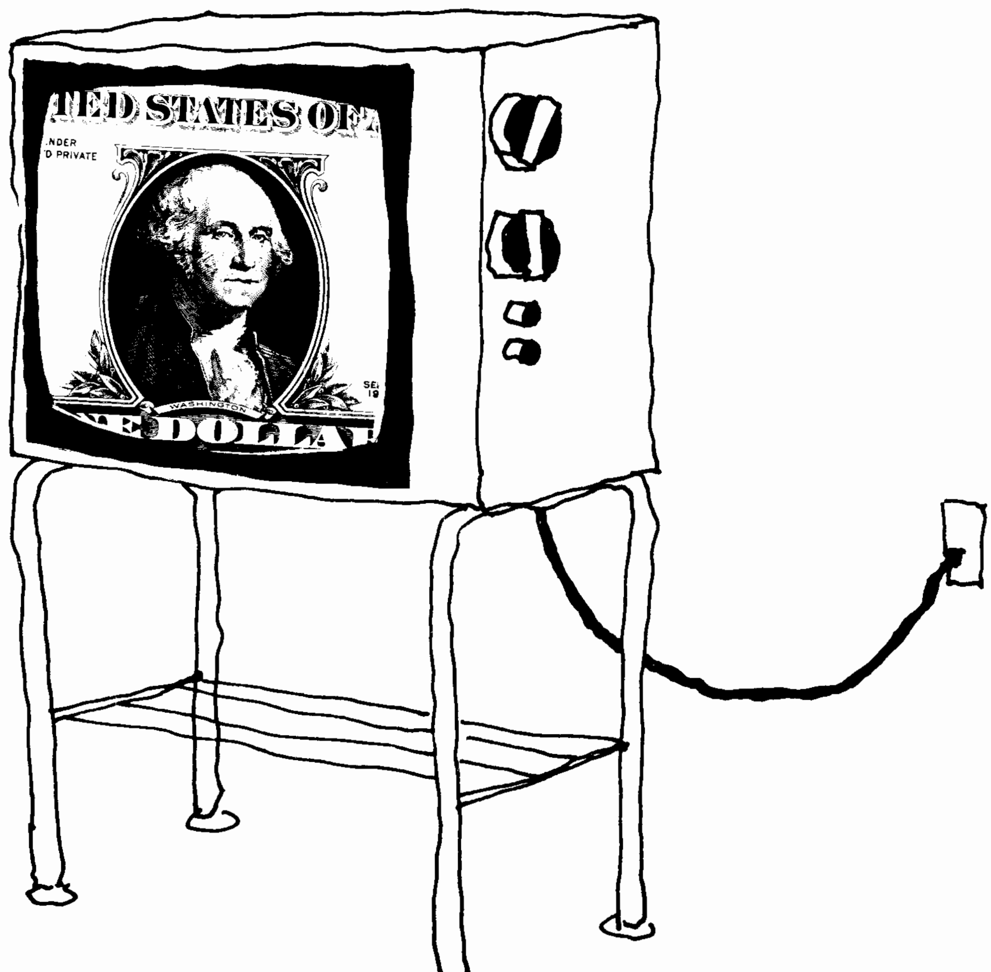

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CATJ

DECEMBER 1975

VOLUME 2-NUMBER 12

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—CONTENTS—

OUR COVER

Good Grief. . .I knew I should have put a beacon on that 199 foot tower! At the CATJ Lab site near Oklahoma City, Stormy Weathers, President of U.S. Tower and Fabrication Company (Afton, Oklahoma) surveys the damage after you-know-who and his you-know-what piled into one of our towers during a pre-25th "test flight". Below the top-of-mast mounted Lindsay log are two funny looking cross-polarized "Multi-Mode Polarization" log antennas designed by U.S. Tower's Tony Bickel and currently under test at the CATJ Lab (see October issue, page 10). We'll have a CATJ report (part 2) on Multi-Mode CATV antennas in January or February.

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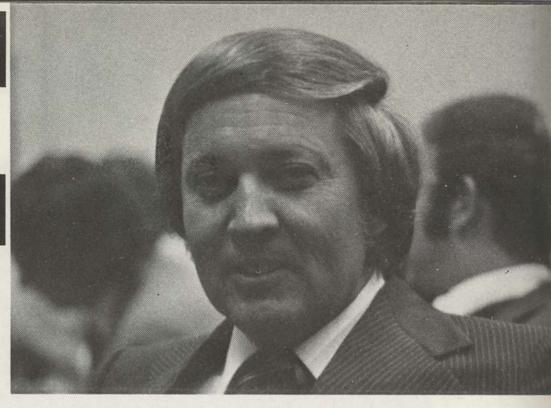


KYLE D. MOORE, President of CATA, Inc.

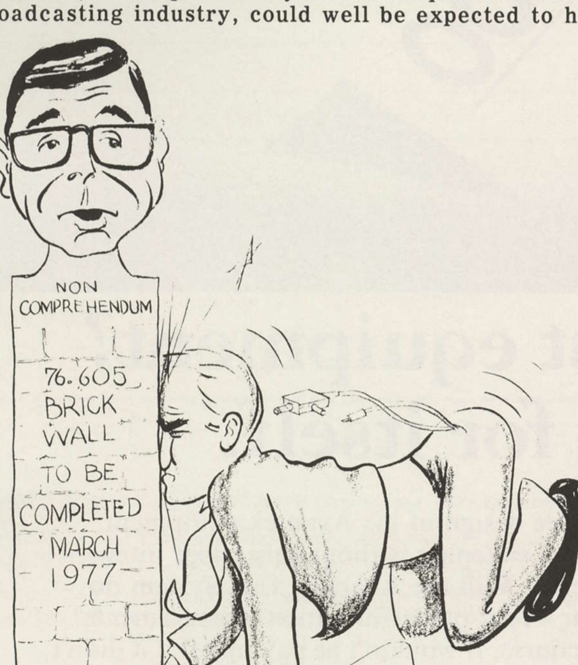
WHEN IN DOUBT — MEASURE IT

Inspite of recent FCC actions to relieve **certain aspects** of the onerous 1972 Report and Order, there appears very little likelihood that systems operating **prior** to March 31, 1972, will be excused from certain **technical** performance measurements and **compliance** responsibilities by March 31, 1977.

Thus, in less than 16 months, **all** systems will be required to have systems whose operation meet or exceed the requirements of 76.605 (a) 1-12. If my recent visits with other operators is any indication, probably fewer than 20% of so-called grandfathered systems would today even come **close** to meeting **all** of the 605 requirements. That leaves 80 percent of us who have 16 months to upgrade our system's operating parameters... **or else.**

The **or else** has some interesting ramifications. Today, **right now,** the **or else** boils down to the FCC withholding your Certificate of Compliance. Your failure or refusal to make technical specs earns for your system a black mark in the FCC's files; but they have no **real** authority to do much else.

But March 31, 1977 is not so close that in the interim the Commission might not find **additional** powers to exact additional tribute from you if you openly (or passively) **refuse** to bring your system up to spec. For example, Senator Warren Magnuson has introduced a bill before the U.S. Senate which would empower the FCC to levy and collect fines (monetary) against CATV systems found to be in violation of FCC rules. Such fines, based upon the way such techniques work in the broadcasting industry, could well be expected to hit $10,000.00 (or more) for repeated refusal to obey FCC rules.



There are other "sneaky" things the Commission **might** do in the interim, or in the event the Magnuson bill fails to clear both houses of Congress and be signed into "law". For example, the FCC **could** probably dream up some method of sending out an attachment to their 1976 annualized reporting form which would include a space for you to swear your system does (or does not) "comply with applicable provisions of 76.605 (a)". This would present **you** with an interesting **choice;** tell the truth and admit your system does **not** comply (for which there would be no instant retaliation but for which you would surely get inspected again and again and again), or, **perjure** yourself and swear that it does comply. If you chose the latter, the Commission would instantly have you for $10,000.00 fine and criminal punishment for falsely swearing to them. If you doubt this, look at the bold print on the bottom of Page 2 of your 325 form. The warning is there **also,** and in fact, **if** you have been less than truthful with your 325/326 information, they already have you for a possible $10,000.00 fine and a bunch of grief...

Let's face it, we are regulated by **basically sneaky regulators** who are going to hang us for dead when we cross them, whether they have the authority to do so or not.

So you have a decision to make, and soon. There are a few slim chances that perhaps (just perhaps) the Commission may lose a court case or two between now and March 31, 1977, thereby invalidating their general regulatory authority over CATV. It is a **slim** chance at best, but it **is** a chance. If you like long odds, you can put off those rebuild areas which you know you are going to have to do before March of 1977.

On the other hand, if you believe the all encompassing powers of the Commission are going to enlarge, not shrink, then you have precious little time remaining to embark on the rebuilding program. Like it or not, 1976 is your last full year to get the job done.

When the FCC announced its full text of the 1972 Report and Order in March of 1972, the manufacturers serving this tiny industry felt they could not help but see better days. Between the rebuild requirements and the tremendous new plant construction most **expected,** they just **knew** that happy days were here again. Alas, it did not happen. According to a **CATJ** survey taken during the past August-September period, between mid-1974 and mid-1975 this industry added less than 7,000 miles of new CATV plant to the **existing** 3,300 systems. That amounts to just over two miles per system (feeder and trunk combined) in that 12 month period. Seven thousand miles may sound like alot to the average person; it is **barely** enough to keep **one** medium sized plant gear supplier running at 80% of capacity.

So going into 1976 we have the certainty that whereas we may not be **required** to have 20 channel capacity in our **grandfathered** major market systems, we do have the 99% likelihood that all systems, major market or not, are going to have to provide service at **least** compatible to the requirements of 76.605 (a) within 15-16 months. That **is** going to take some new equipment, and it **is** going to take some concentrated effort to get the job done before the deadline.

This issue of **CATJ** begins our second (annual) look at (1975/76) Compliance Test Measurements. This is the last **dry run** for grandfathered systems. The next time you do these tests, **they will be for real.**

In the proper spirit of a dry run, you shake down the system's operation, find out where the bugs are, and use

what you learn in the dry run to make it possible for the real thing to come off without a hitch.

Now, if 80% of all grandfathered systems would not pass 76.605 (a) today, I believe it is fair to say that no more than 50% of all grandfathered systems have made any of the required dry run tests **to date.** If my own confidential visits with system operators means anything, if the number of systems ordering the CATV 1974/75 Compliance Test Booklet (last year) proves **anything**, it is that most systems **have just not accepted** the reality of 76.605 (a) measurements yet. There have been just enough people ordering the CATJ Test Book, just enough people talking about what they found in their own tests, and just enough business for the free-lance consultants to suggest to me that perhaps 1 system in 2 has actually made **any** tests. That includes the systems owned by the larger MSO's who have the money and talent to have working test programs of their own. If the independent operators, the small MSO's and all of those who simply don't understand the test requirements are separated from the MSO systems that have the bucks to comply, I would venture the estimate that no more than 1 system in 4 has done his pre-75/76 Compliance Testing. Many of these, I note with enlightened interest, have made their tests by sending **CATJ** $25.00 for a copy of the Compliance Booklet, and then filling in the numbers over a can of beer from the comfort of their cozy office.

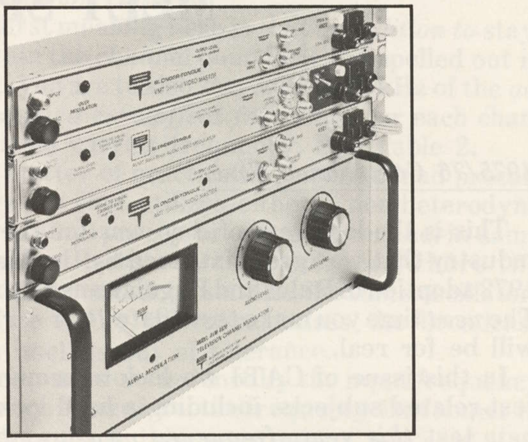
Again, I note that it appears very likely that the rudimentary requirements of 76.605 **are going to stick.** The Commission still has some unfinished business as relates to 76.605 (a) (9) —visual signal level to system noise/co-channel, and, 76.605 (a) (10) —visual signal level to intermod and discrete carriers. But we expect these cliff hangers to dissipate before we are very far into 1976.

So we suggest that you **rethink** your own approach to this year's tests. The mold has probably already been created. Either you have ignored the tests **thus far**, or you have cribbed a little (or alot) on the test procedures. Many of the tests **can be** performed with an SLM/FSM and a DC coupled scope. Many of the tests can be approximated with a TV receiver and a trained eye. The rules say that **all** tests must be made this year; and, **they all count next year.** This issue of **CATJ,** continuing into the January issue, deals extensively with the tests required and the procedures involved. At the very least, we urge you to adopt the spirit of the tests this year **and make no less than those you have the equipment available for.** And if you can borrow somebody elses equipment to make some **additional tests, we encourage you to do this.**

We encourage you to make the tests as completely and as honestly as you know how, **this year.** We encourage you to use the tests as a means of determining exactly **where** your system does not meet the requirements of 76.605 (a), and we urge you to take your own test results and talk with one or more of your favorite equipment suppliers about **what it will cost you** to come into **full** compliance by March of 1977. If you will do this, now, before the March 31, 1976 deadline for the **current** year's tests, you will at least have full knowledge of your own compliance liability. The cost of full compliance may **shock** you, or it may **surprise** you. **But at least you will know,** which I suspect is not true for a majority of the systems today. Later on in 1976, say April, we intend to conduct a survey of the industry here in CATJ. We are going to ask you just a few simple questions, starting off with **"What will it cost your system to make full compliance with the requirements of 76.605 (a)?"** If our survey results are **extensive** enough, and if the numbers are **accurate** enough, then we **may** have the ammunition to **go to the Commission** and seek a **postponement** of the March 1977 deadline.

But I warn you in advance, **the numbers are going to have to be accurate,** CATJ Test Compliance Booklets cribbed from the warmth of your office and stained with coffee or some other beverage will not help **us** convince a reluctant FCC that we **need** more time to comply.

Resolve that you will make the tests, and do them to the very best of your ability. Then we'll talk about them again in our April issue.



SUPPOSE YOU MEASURE IT AND DISCOVER YOU DO NOT MEET SPEC? THEN WHAT!

1975/76 Compliance Tests

This is the last year of *dry runs* for the CATV industry that was grandfathered by the March 31, 1972 adoption of Rules and Regulations by the FCC. The *next* time you make tests (late 76 or early 77) it will be for real.

In this issue of CATJ we look at a number of test-related subjects, including a hard look at the *new* test *this* year: *frequency measurements*. In the January (1977) issue of CATJ, we will go through the balance of the tests not included in this month's coverage.

The dry-run tests (i.e. those conducted for the past several years) have been primarily designed to ease us into the "test posture," a step at a time, and to help us spot on our own those sections of our plant where non-compliance will result in our having to rebuild, redesign, or correct for non-compliance.

Because 1976-77 Compliance Tests are for real (i.e. all tests due by *March 31 of 1977* must show system conformity to applicable rule sections), this then is our last opportunity to "spot" problems. 1976 is the last *complete year* to correct problems.

Up until March 31, 1976, the dry-run tests have been mandatory but not hazardous to our health. That is, if we failed to make them, our jeopardy was minimal (see CATA-torial, Page 4, this issue). On the other hand, if we fail to make tests by March 31, 1977, and we also fail to comply with the applicable technical provisions of the 1972 Rules at that time, we have a form of double jeopardy. We failed to make the tests, and we failed to make technical compliance. The risks, even in the present FCC posture of very little real enforcement powers, are very real, and eventually they can also be expected to be very costly.

On the assumption that you *will* make the required tests this year, let us explore what these tests mean. Individual detailed discussions of test procedures will follow here and in January. Our primary purpose at this point is to look into the *type of corrective actions* which might be required of you if your test results indicate your system is out of compliance in certain areas.

MEASUREMENT POINTS

Compliance test measurements must be made at no fewer than three separate in-plant locations, one of which must be the equivalent of the most-distant cable point from the headend. The tests need not be performed inside a home, but if performed at an unused tap equivalent to the home location, all measurements should be made by allowing for the additional cable loss and tilt of the drop cable into the residence being simulated. The simplest way to do this is to unroll a piece of 59 drop cable equal to the length of the drop and connect it to your test-point tap.

73.605 (a)—Technical Standards

"(a) The following requirements apply to the performance of a cable-television system as measured at any subscriber terminal with a matched termination, and to each of the Class I cable-television channels in the system:".

Which simply means that all measurements are to be performed at a subscriber's service location, utilizing 75-ohm test equipment across a 75-ohm cable line, and that all tests to be discussed are to be performed on all off-the-air fed cable channels.

The headend end, by *strict* interpretation, is *not* a subscriber's location unless you can convince the FCC that a paying customer lives there. The Commission has noted that a system may make its measurements at three subscriber locations (76.601 [c]) *"At least one of which is representative of the terminals most distant from the system input (headend) in terms of cable distance."* We will have more to say about measurement techniques subsequently.

"(1) The frequency boundaries of cable-television channels delivered to subscriber terminals shall conform to those set forth in 73.603 (a) of this chapter; provided, however, that on special application including an adequate showing of public interest, other channel arrangements may be approved."

The meaning here is that according to 73.603 (a), standard television allocation channels shall be provided. This means that channels 2-13 shall be within the boundaries established for broadcast television services (see Table 1). Not all systems meet this requirement *today*. Many systems, constructed in the late 50's and 60's, and in particular those operating with local demodulators/modulators, placed signals on slightly different-than-official channel assignments. For example, many systems channel "2 minus 1" or channel "2 minus 2." Rather than carrying channel 2 on 55.25 MHz (plus or minus some *reasonable* amount), channel 2 is cable-car-

ried on 53.25 or 54.25 MHz, a frequency generated *with the CATV modulator*. The technical reasons for this *were* excellent at that time; they are *not* bad *today*. By moving down a MHz or two, a *space* was created between channels 2 and 3, a buffer space that helps TV sets separate two adjacent channels. All TV sets can fine-tune down that extra MHz or two without much difficulty; subscribers got better service as a result.

TABLE ONE – TV Channel Assignments	
Channel 2	54- 60 MHz
3	60- 66 MHz
4	66- 72 MHz
5	76- 82 MHz
6	82- 88 MHz
7	174-180 MHz
8	180-186 MHz
9	186-192 MHz
10	192-198 MHz
11	198-204 MHz
12	204-210 MHz
13	210-216 MHz

If channel 2 was moved down two MHz, channel 3 was often moved down one MHz (i.e. channel 2 on 53.25, channel 3 on 60.25), thereby creating 1 MHz buffers between 2-3, 3-4. There is a natural four MHz buffer between 4 and 5. Then 6 was moved up one or two MHz ("6 plus 1 [2] MHz"). This created a one or two MHz buffer between 5 and 6; making it easier for all TV sets on the system to function without adjacent channel interference.

Any systems *still* employing this practice (and *some* still do) will either have to replace their existing modulator or recrystal their existing modulator for the standard TV channel assignments. Or they will have to go to the Commission and ask for a waiver based upon "an adequate showing of public interest."

Of the three choices, recrystaling the existing modulators is by far the least expensive way to go. However, all of the receivers on the system will have to be readjusted (fine-tuning usually all that is required) in the process. And if some of the older sets have functioned better without the FCC standard 6 MHz spacing between channels, you may find that by moving the channels back into the *assigned* segments that their I.F. selectivity is not adequate to produce interference-free pictures. This is bound to cause some subscriber problems.

> "(2) *The frequency of the visual carrier shall be maintained 1.25 MHz +/– 25 kHz above the lower boundary of the cable-television channel (see Table 1), except that those systems that supply subscribers with a converter in order to facilitate delivery of cable-television channels, the frequency of the visual carrier at the output of each such converter shall be maintained 1.25 MHz +/– 250 kHz above the lower frequency boundary of the cable television channel."*

The first meaning here is that *in addition to* staying within the channel boundaries as spelled out in Table 1, you are to also stay within 25 kHz of the *actual assigned zero-offset frequency* for each channel's visual carrier frequency. See Table 2.

As a matter of practicality, any headend processing system that utilizes either a non-heterodyne (i.e. strip-amp) processor or a same channel in-same channel out heterodyne processor (where the down-and-up converters utilize the *same* oscillator) *cannot be out of tolerance* unless the broadcast station itself is out of tolerance.

A strip amp does *not* modify the input frequency in any way. Therefore, the frequency that comes in is the frequency that goes out.

A heterodyne processor that uses *one oscillator* to beat the *incoming* signal down to I.F., and then uses the *same oscillator* to beat the I.F. signal back up to "on channel" likewise *cannot* modify the off-air as received signal. *If this fits your situation*, you

TABLE TWO–TV Channel Operating Frequencies

Channel	Visual Carrier	Aural Carrier
2	55.250 (55.225-55.275)	59.750 (59.725-59.775)
3	61.250 (61.225-61.275)	65.750 (65.725-65.775)
4	67.250 (67.225-67.275)	71.750 (71.725-71.775)
5	77.250 (77.225-77.275)	81.750 (81.725-81.775)
6	83.250 (83.225-83.275)	87.750 (87.725-87.775)
7	175.250 (175.225/275)	179.750 (179.725/775)
8	181.250 (181.225/275)	185.750 (185.725/775)
9	187.250 (187.225/275)	191.750 (191.725/775)
10	193.250 (193.225/275)	197.750 (197.725/775)
11	199.250 (199.225/275)	203.750 (203.725/775)
12	205.250 (205.225/275)	209.750 (209.725/775)
13	211.250 (211.225/275)	215.750 (215.725/775)

NOTE: Aural carrier must be within +/– 1 kHz of 4.5 MHz (i.e. 4.449 to 4.501 MHz) of visual carrier, above.

are probably OK unless you are carrying some Mexican stations or some VHF translators. The Mexican stations may or may not meet the +/— 25 kHz criteria (things tend to be a little loose south of the border, in spite of Joe Garcia Moll!); and VHF translators, while they are *supposed* to meet the criteria, tend to be something less than perfect.

Whose responsibility it is to clean up an off-frequency input signal so that on-cable the output frequency is within +/— 25 kHz is not clear at this point. It is logical to assume that your defense is pretty good if you are not doing anything to the signal that changes its cable-carriage frequency away from its off-air signal frequency.

However, systems that use heterodyne processors that *receive on one* channel (i.e. 2) and *cable-carry on another* channel (i.e. 8, or M, etc.) can easily be "out of spec." If the *input* frequency is to FCC tolerance specs for broadcast signals, then it follows that the misconversion of the channel *is your fault.* The same problem is true if you are using a modulator (fed by either an in-headend demodulator or via a microwave feed).

How you correct this is a matter of analyzing the extent of the cause of the problem. If your modulator is old and it simply wanders around (i.e. the crystal is perhaps no longer stable or the modulator is self-excited), repairing the older unit may not be practical. On the other hand, if the modulator is reasonably *stable* but simply *off-frequency,* you are probably looking at replacing the crystal with one that puts you on the proper outward-bound frequency; one that meets the +/—25 kHz spec. If the unit is only *slightly* out of spec, you can probably order a new crystal for it and simply replace the existing crystal with the new one, perhaps touching up the oscillator tuning slightly in the process.

FREQUENCY MEASUREMENTS

If you have no conversion channels (i.e. no UHF to VHF, or VHF to VHF where the input VHF channel [off air] and the output VHF [on cable] differ) you can ignore the requirements for frequency measurements. Frequency measurements are only required on channels on your system which originate on one off-air channel and end up on the cable on another cable-carriage channel.

If the oscillator is crystal controlled (virtually all are; if you have one or more that is not, you are headed for a replacement anyhow) and there is a "padder capacitor" across the oscillator crystal, *perhaps* you can tweak upon the padder capacitor and "pull" the oscillator back to within tolerance. Many oscillators have padder capacitors (usually variable trimmers) which were designed into the circuit for just that circumstance, to allow the initial alignment tech to *walk the frequency* around just enough to send it out of the factory on frequency. These crystals, the oscillator circuit components, and the trimmer (padder) capacitor tend to change characteristics with time. *This may be your only problem;* and you can walk it back with the aid of a frequency counter, tied to the output of the modulator.

This applies to both modulators and the *up*-converter crystal (oscillator) in heterodyne processors that go out on a different channel than they come in on. *A word of caution*—do *not* try to bring yourself back onto frequency with a heterodyne processor by tweaking upon the *down converter* (i.e. RF to I.F.) *oscillator.* You will walk yourself around, all right, but in the process you will also find you have walked *away* from the carefully aligned I.F. of the processor. This will result in the I.F. no longer matching the down converter output (to I.F.) frequency range, decidedly *bad* news for the I.F. section of the processor.

If all of these self-help tricks fail, you are probably in the market for a new processor.

Now what happens if you have a converter *at the home.* What does this "+/— 250 kHz" business mean? Simply this: as your converter (set-top, etc.) takes in cable-carried signals and converts them to the converter output frequency (i.e. typically channels 3, 4, 5 or 6), the *output* of the converter must be within +/— 250 kHz of the channel assignments shown in Table 2.

Humm. That *is* some trick. If the converters *we* have looked at are *any* indication of what nearly 1.5 million U.S. homes have in them at the present time, hitting within +/— 250 kHz on *every* converter in the system ought to be about a million-to-one shot; perhaps not even that good. That is, nonetheless, *what the spec calls for,* and we report it for what it is.

Now as to how you make sure you are doing this: simply measure the output of the subscriber's converter on a counter following techniques described elsewhere in this issue of CATJ.

But what if they don't make it? If, as we suggest and suspect, the chances of doing this with every converter in town on every channel are a million-to-one shot, *what* are the ramifications to non-compliance? We suspect that nobody really knows at this time, and we suspect that this sub-sub section was composed and released by the FCC after they took a *quick* look at some converter manufacturer's *slightly ambitious* 1971/72 spec sheet on an *early* converter.

Reader/industry comments *are* invited.

> "(3) *The frequency of the aural carrier shall be +/— 1 kHz above the frequency of the visual carrier.*"

This is another one of those areas where *it is hard* to be out of spec *unless* you are doing something terribly antiquated and terribly dumb, all at the same time. Every aural TV broadcast signal, assuming it is itself in compliance with applicable broadcast standards, is no more than +/— 1 kHz from being 4.5 MHz above the same signal visual carrier. That *is* the nature of the beast.

Now how do *we* get further apart than the desired and specified +/—1 kHz? By taking the aural and the visual carriers *apart* at the headend; by

demodulating them both and then by coupling their demodulated signals out of the demodulator to a CATV modulator where the modulator derives its own operating frequencies with *very* sloppy oscillator(s) control.

Most CATV modulators derive the aural carrier by beating a precise 4.500,000 MHz crystal against the higher frequency visual carrier oscillator. Thus, for example, if a 55.250,000 visual carrier oscillator (channel 2) is beat against a 4.500,000 aural carrier frequency, the net result at the *output* of the modulator is a visual carrier on 55.250,000 *plus* an aural carrier at 59.750,000 (55.250,000 *plus* 4.500,000). A 4.500,000 MHz oscillator *should* be a pretty stable animal. As long as it is stable, it will *always* beat with the visual carrier oscillator signal and end up 4.500,000 MHz above the visual carrier.

And if it does *not?* What *is* the problem?

Some *very* inexpensive CATV modulators have been *known* to have such lousy 4.500,000 oscillator circuits that in the process of aligning the beasts the 4.500,000 signal ends up on 4.495,000 or some other frequency which is *not precisely* 4.5 (etc.). Such modulators often have the tendency to lose their aural carrier (i.e. *it just drops out* because the poorly designed 4.5 MHz oscillator is not stable in temperature changes). *That should be a warning* to you if you have such a modulator; chances are that 10% of these could be cured by replacing the oscillator crystal with a new 4.5 (etc.) MHz rock; but the chances are 90% that the problem is *not* the crystal, it is the *lousy* 4.5 (etc.) MHz oscillator circuit.

AURAL FREQUENCY SEPARATION

If your system uses no baseband video/audio (from a demodulator or from a microwave feed) to drive a CATV modulator carrying on off-air signal, you may skip the measurement of aural carrier frequency integrity, reference the 4.500,000 MHz space required between visual and aural carriers. Only systems employing modulator techniques where the modulator could create an inaccurate frequency for the aural carrier need to be measured.

With the exception of these *cheapy* modulators, if the unit has perked along with no problems for years but seems to be off frequency when checked, then we suggest the first thing you do is look for a *padder capacitor* across the crystal. Tweak upon it, observing the aural frequency (or better yet, the output of the 4.5 (etc.) aural modulator) on a frequency counter. When it reads 4.5 followed by a bunch of redundant zeros, back off and leave it alone. But watch it for a few days to see that it maintains the frequency.

If it does not, *then* you can try having the crystal replaced with a new 4.500,000 MHz crystal. If that *still* does not solve the problem, the oscillator itself is suspect. If it can be repaired or stabilized, this is preferable to starting all over with a new modulator.

In summary, unless you have a *modulator* carrying an *off-air* (i.e. Class I) signal, you can fairly assume that you *are in* spec with this section.

"*(4) The visual signal level, across a terminating impedance which correctly matches the internal impedance of the cable system as viewed from the subscriber terminals, shall be not less than the following appropriate value:*

Internal Impedance	*Visual signal level (mV)*
75 ohms	*1*
300 ohms	*2*"

The FCC makes everything so complicated! This means that when you plug your 75-ohm drop cable F fitting into your 75-ohm SLM/FSM, that no channel (class I) shall measure less than 0 dBmV, on the visual carrier. If you are still running around in microvolts and millivolts, that is 1,000 microvolts or 1 millivolt.

And if it is not?

You need *more* signal. It is *that* simple. Change out the value of the tap. If you are down in the 6/7 dB *isolation* level already, change out the drop line to a lower loss cable (such as RG-6). If you are so *far* down that this will not help, *put in an amplifier.* But make sure that when you get done that *any* off-the-air channel you carry on the system reads *at least* 0 dBmV across the end of the drop cable, as it would normally plug into the matching transformer on the back of the receiver. *And then you will comply.*

"*(5) The visual signal level on each channel (Class I) shall not vary more than 12 dB within any 24-hour period, and shall be maintained within: (i) 3 dB of the visual signal level of any visual carrier within 6 MHz nominal frequency separation, and (ii) 12 dB of the visual signal level of any other channel, and (iii) A maximum level such that signal degradation due to overload of the subscriber's receiver does not occur.*"

The part about varying more than 12 dB was added in the June 1972 "Reconsideration" of the 72 Report and Order. It means that you cannot take a *best* shot. . . *unless the best shot lasts for at least 24 hours.* Sitting there with an SLM *waiting* for the levels to stabilize to the point where no two immediately adjacent signals vary in level more than 3 dB from visual carrier to visual carrier, or 12 dB from lowest drop visual signal level to highest drop visual signal level won't "plant." If you are going to sit there waiting for everything to "sync" so you won't have to crib the test results, you would be better spending your time fixing the plant or headend problem that is *causing you* to sit there in a trance for several days (or weeks)!

The 24-hour business really means that within a full-day test period, the *worst case example* of level changes (as described) shall *not* be greater than (1) 3 dB level variation from one channel to *either* of its *immediate* adjacent channels, or (2) 12 dB between the strongest visual carrier delivered and the weakest visual carrier delivered. And in no case shall you deliver so much signal to the drop that the

set overloads.

If two immediately adjacent channels are more than 3 dB apart, you probably have a headend problem, which most likely can be corrected by merely readjusting the appropriate headend channel level control. If you find that the headend levels *are proper* but the plant levels are falling more than 3 dB apart on adjacent channels (or between two adjacents), the *first* thing to do is to determine *where* on the plant this is happening. It is probable that if you start at the point where you notice this discrepancy and work *backwards* towards the headend you will discover a section of plant or a particular piece of equipment where the level discrepancy is taking place. In some situations where a defective line splitter or DT (or pressure tap) is in a feeder line, a *"suckout"* can occur on one or two channels. This *type* of problem sometimes is so baffling that the *suckout* may only affect *a small section* of the feeder (or trunk) line; with one or two channels dropping dramatically in level for a drop or two and then *reappearing* shortly thereafter.

24 HOUR TEST PERIODS

The Commission requires that certain tests be made over 24-hour periods to ascertain that the system being measured is completely stable in time. Lacking a chart recorder which can run and record levels unattended, most systems are making three to five random spot checks during a 24-hour period to ascertain that tests requiring 24-hour stability checks are accurate. The Commission thus far has failed to announce what technique they approve.

If the level discrepancy is noticeable on the *trunk* but is very *gradual* as you get further and further from the headend, there is something decidedly strange occurring in the trunk amplifier *tilt* equalization. A gain "spike," of perhaps *only* a 1/2 dB or less per amplifier, *cascaded* through several (dozen) trunk amplifiers can build one or two channels to unusually high (or low) levels through a long section of plant. In this case, the change *amplifier to amplifier* may be *so small* as to be hardly noticeable on a typical SLM; it takes *jumps* of 3-5 amplifiers *between comparative* measurements to spot the up (or down) "spike" *trend*.

So a 3 dB level discrepancy that does *not* fit the headend level relation between two *immediately* adjacent channels must be traced down; *large* discrepancies are usually feeder-line oriented and can be traced to one or more passive devices in the line (although it can happen in a trunk-line passive device also, it is *usually* limited to feeders). A *gradual* shift of levels is usually not particularly noticeable *on feeder lines*, simply because the *number* of line-extender amplifiers *in cascade* is seldom great enough for the "mistilt" to build up in such a *short* span of amplifiers.

Normally this problem can be corrected by (1) locating the defective passive unit by a series of repeated measurements, and isolating the suspect unit; or (2) realigning amplifiers which *cumulatively* are adding an unwanted up or down level spike to one or two channels in the system.

In some unusual situations (but not rare), the problem spike can be traced to a very bad VSWR (match) associated with a connector, a passive equalizer, or even a power insertion point from a line-power supply. In any case, if the unwanted spike can be *measured at a subscriber test location*, it can be traced backwards and either (1) specifically spotted and isolated to *one* unit, or (2) can be found to be the *cumulative* effect of amplifier response nonlinearities.

Finally, suppose the level delivered to the set is *too hot* or is too badly tilted due to the length of the drop cable. A too-hot level is simple to cure: put a *pad* in the line, for that receiver. Different model receiver chassis require different amounts of signal before they lose effective AGC action. In some sets, a +10 dBmV level is borderline too hot.

If the cable drop is excessively *long* and you end up at the set with (say) +14 dBmV on channel 2 and 0 dBmV on channel 13 (2 dB out of spec), your problem is best cured with a *subscriber passive equalizer*, such as the RMS model 2200 or the Q-BIT 4200 units.

"(6) The RMS voltage of the aural signal shall be maintained between 13 and 17 dB below the associated visual signal level."

This is basically a *headend control* problem, although it is *not* impossible for it to occur *within the plant*. This is a much bigger problem than many people realize, especially with certain design types of headend processing equipment.

Virtually *every* common type of headend processor has *some* form of automatic gain control (AGC). Heterodyne processors (with one possible exception) individually AGC the visual carrier level *and* the aural carrier levels in the processing process. This means that a control is placed on the "swing" of the visual carrier to counteract signal fading (up or down). Without an AGC system, every signal fade, every passing airplane would produce wildly *fluctuating* signal levels all through the plant. With a multiple-channel plant, this is obviously not desirable.

In heterodyne processors that individually AGC the visual *and* aural carrier level signals, *if the visual decides to fade* while the aural stays *constant*, the AGC on the visual clamps the visual output level constant (within the AGC window range); and the aural AGC *sits there* with *no* job to do. Then *if the aural carrier decides to fade* while the visual carrier *holds* stable, the aural AGC does its job and clamps the aural level output to the plant constant. Therefore, if you set the output level control on the headend processor for the visual carrier level required to drive the trunk line out of the headend, and then adjust the "*sound* level control" (which really adjusts the aural *carrier* level) to a point where the aural carrier is from 13 to 17 dB (that's the spec of 76.605 [a] [6]) down from the visual, you *should* be all right from that point on. If the *aural* fades, the *aural AGC* goes to work; if

the *visual* fades, the *visual AGC* goes to work. If *both* fade at the same time, *both* go to work. And in any event, the technician-adjusted level difference (13-17 dB) *is maintained.*

Now what happens if you have a processing system that does *not* have independent AGC for the aural and visual carriers? There are such animals; virtually all versions of on-channel (non-heterodyne) signal processors AGC *only* the *visual* carrier. The aural is left to *run up and down on its own.* Now as long as the visual and aural fade *at the same time,* and by the *same* amount, the visual-only AGC is *all* that you *really* need. But when the two signals fade *separately,* and especially when the aural fades while the visual is relatively constant, you either *lose* the aural signal on the channel, *or it comes up* and overpowers the next higher adjacent channel.

Such a headend system would probably have *difficulty* complying with 76.605 (a) (6), for a 24-hour test period. If you are relatively *close* in to the transmitting station (*such as within Grade A contour*), the mathematical chances that the visual and aural will fade *separately* (i.e. selective fading) *is very small,* on the order of 1,000 to 1. But as you go *further and further* into the B contour, and especially as you *leave* the B contour and move into the *scatter* region (*see CATJ for October, 1975; Page 10*), the mathematical odds that visual and aural will fade not in unison *approaches 50%* (i.e. half the time). *Scatter-level signals,* outside any direct reception range, *fade separately* whenever there is no tropospheric enhancement present.

So *what* do you do about it?

If you have a heterodyne processor and you find that you have an aural carrier varying *outside* of the headend set 13 to 17 dB down region, the first thing to do is to *recheck the headend* or someplace further back along the trunk to make sure the problem is *not* one of those weird "spikes" caused within the trunk, or feeder. If the variation out of spec is *stable* (i.e. it does *not* change while you monitor it for a while), chances are good you have a *"spike"* problem. Follow the same suggestions for 76.605 (a) (5) to locate and fix the problem.

If you find in checking that the problem is present all the way back to the headend, then your *aural AGC* (assuming visual level *is* proper level) is malfunctioning. See your service manual for your headend processor unit.

If you are employing a strip or on-channel system that has *no aural carrier AGC,* your problem may be temporary (i.e. freakish and *not* to be concerned about), or it may be a pretty *regular* thing. If you are outside of the A region, but barely, chances are you *can ignore* the indicated discrepancy. If you are *well* into the B, or out in the scatter region *beyond* the B, you probably are *only* going to solve the problem in *one* way: *replace the processor* with another unit that affords *separate AGC* over both visual and aural carriers.

> "(7) *The peak-to-peak variation in visual signal level caused by undesired low-frequency disturbances (hum or repetitive transients) generated within the system, or by inadequate low frequency response, shall not exceed 5 percent of the visual signal level.*"

Like we said earlier, the FCC makes everything *very* complicated. What they are saying here is that you shall not have *more than 5% hum modulation;* whether it is caused by a defective plant power source (i.e. 30 or 60 VAC supply), or by whatever other source might be expected to generate hum.

Elsewhere in this series we talk about *how* you measure hum. There are several techniques available. The one we *like* best is the eyeball test. *If you can see a hum bar* (faint to slightly dark grey bar on the screen, about 15-20% of the screen width, sometimes moving up the screen *slowly*), *you have 5% or more hum mod.* The 5% figure sanctioned by 76.605 (a) (7) is really rather *generous.* Most CATV subscribers would *not* put up with that *much* hum mod.

Let's assume you find some. What next?

Hum mod is introduced into the system by some active or passive device not filtering the 60-cycle repetitive waveform AC properly. This can happen at any number of points; in fact it *can* happen wherever AC powering is present *with* RF signal.

First *isolate* the following:

(1) Is it *frequency* sensitive (i.e. only on one or a few channels)?

(2) Is it *location* sensitive (i.e. only in certain parts of town)?

If it is very frequency sensitive (such as on one channel), *immediately* head for the tower site. Check the input signal *to the processing gear* for that channel and see if you see it here (if you do, and you have a preamp, that is probably where it is happening). Then check the *output* of the processing gear. If the *input is clean* of AC hum but the output has it present, then someplace inside of that unit (the processor) some 60-cycle AC is getting into the RF circuitry. There are literally dozens of possibilities. Suffice it to point out that it can be cured with either a 10-cent AC bypass disc capacitor, an RF choke, or both. If the unit has recently developed the problem, then something has broken down inside. If it came that way from the factory, you should not have accepted the unit in the first

SMALL SYSTEM? CAN'T AFFORD NEW PROCESSORS?

If the sales data provided by Blonder-Tongue Labs is any indication of the approximate number of systems utilizing strip amplifiers for headend signal processing, there are literally thousands of CATV-cable-channels operating without separate AGC on visual and aural carriers. In the forthcoming April CATJ we will conduct an industry-wide study of how much it will cost you to comply. At that time, if your headend cannot meet the requirements of 76.605 (a) (6) because you have non-aural-AGC'd strip amps, we will ask you to tell us about it; and combined with all other systems reporting, we will in turn advise the Commission of the extent of the problem nationwide.

place.

Then if you are still clean coming *out* of the headend channel processor, start working into the plant. Check the trunk input *at the headend* and then head down the trunk toward town checking for the point where the signal (i.e. channel) *picks up* the hum mod.

The *most* obvious place for AC to get into RF (and thereby modulate the RF signal with the 60 cycles of the AC signal) is at a power insertion point on the plant. Here again, the problem is likely to be a bad bypass capacitor or an RF choke, but in no case should it be a major problem. It will take you far longer to isolate it than it will to fix it.

Don't overlook some of your *passive* equipment. There were some peculiar problems with a brand "A" directional tap many (many!) years ago where *they rectified the RF* and then AC modulated the RF signal going through the plant at that point. Until you have seen a DT cause hum mod, *you haven't lived!*

In *almost* all cases, if the AC hum is showing up *after* the headend, it will show up on several (or all) channels. It *may* only be on low band, or it may only be on high band, or it may be on all channels. The intensity may vary from channel to channel (or low band to high band); this is simply a function of the *RF signal levels* present at the point where the AC modulating voltage decides to "marry" the RF levels.

It may *not* crawl up the screen at all; it just may sit there at some point, although the point at which it comes to rest may vary from channel to channel. On some channels it may be tucked up *under* the frame bar, so it *appears* it is *not* present at all (*it is*, you simply can't spot it without "lifting up the eyelid on the top of the screen" and peering through the frame bar).

Finally there is the matter of *"repetitive transients caused by inadequate low-frequency response."* This is basically a microwave problem. It may be *your* microwave *demodulator* that is causing the problem, or it may be someplace down the microwave circuit.

Microwave demodulators employ a device known as a "Video Clamp Amplifier"; a clever scheme that performs an AGC-*type* function for the video signal spilling out of the microwave carrier after demodulation. In some Video Clamp units the "clamping" is "too severe." This can manifest itself as a signal that refuses to hold stable vertical sync (because the sync pulses are being destroyed or badly bent by the clamp) or by our old friend hum mod. *Or both, at the same time.* This is *not* usually a power-supply-related problem. It is a video-AGC problem, relating to the misadventures of the video clamp circuit. If you buy microwave service from somebody else, call *them* to fix the problem. If the demodulator is your own, or you are personally responsible, contact the supplier of the unit or someone with experience in video clamping circuits to straighten it out.

"(8) The channel frequency response shall be within a range of +/— 2 decibels for all frequencies —0.75 MHz and +4 MHz of the visual carrier frequency."

This one is sneaky. The guy who wrote this *never* had to make an off-the-air signal fly on a CATV system with a strong lower adjacent channel signal present on the desired channel antenna array.

What this says is that if you were to somehow figure out how to introduce a *flat* sweep signal (*or* wideband noise source) *into* the front end of your *antennas* (i.e. from *space* out in *front* of your antennas), and then go down to the output of the system at the furthest extremity and measure the degree of flatness of that sweep or broadband noise source, at discrete points 0.75 MHz *below* the visual carrier frequency *up through* the visual carrier frequency and on up to a point 4 MHz *above* the visual carrier frequency, you should *not* find the *flat* sweep/broad-band noise input more than +/— 2 dB *out of flat.*

Nobody can properly hang a sweep source or a broadband noise source *out in front* of their antennas and perform this test. Somebody *could* climb the tower with a Sadelco 260-A broadband noise source, unscrew the antenna lead from the input to the preamplifier (if you use one), and re-attach the 260-A wideband noise source. Then you *could* run to the far end of your plant and measure the flatness of the noise source at that point (assuming it is flat going *into* the preamp). You *could* do this, but you won't.

The FCC has said, informally *and not to be quoted* (nobody wants to stick their bureaucratic neck out!), that:

(1) *If* you have a flatness plot *for your antenna, and*

(2) *If* you have a gain/flatness plot *for your preamplifier,*

then you can, if you wish, simply inject the wideband noise source or the sweep source into the processor input (or into whatever passive preprocessor equipment you might have *ahead* of the processor, such as a BPF or sharp trap). This *is* more convenient than climbing the tower with a 260-A, *but it is still a heck of a lot of work.*

If you have a flatness plot from the antenna manufacturer, and if you have a gain/flatness plot for the preamp, whatever flatness response check you measure, as required by 76.605 (a) (8), must be *modified* by whatever paper deviations you have

THE NO-WIN SPEC

Systems not so located that adjacent channel signals are a problem in headend design may be able to meet the requirements of 76.605 (a) (8). Those with lower adjacent signals present, to clean up before they can AGC and amplify the desired signal, have a distinct problem with this section. In April, when we conduct our survey, we will ask you to tell us which channels you will degrade in the customer's eyes if you are forced to meet this spec.

from your antenna plus preamp plots. If for example, you were to measure a system deviation of —1.5 dB at 0.75 MHz minus (below) the visual carrier level, and the summed *total* of your antenna plot and your preamp plot was an additional —1.0 dB, the FCC says your *total* deviation is now —1.5 and —1.0, or —2.5 dB; which is —0.5 dB beyond the criteria.

Anyone who has a strong (or bothersome) *immediately lower* adjacent channel has stuck in one or more bandpass filters and one or more tuneable notch traps ahead of the processor to drop the immediately lower adjacent aural carrier to a level you can live with. A BPF (with or without built-in traps) or a tuneable trap is *guaranteed* to destroy the response curve of the system *within* —0.75 MHz to the point where you cannot even *hope* to meet this FCC spec. If the BPF or notch trap is *not* destroying the response curve *more than* —2 dB at a point 0.75 MHz *below* the visual carrier, it is probably not doing you much good with the lower adjacent carrier anyhow.

So this is a no-win situation. If you *somehow* manage to meet the system spec, your pictures have just picked up sufficient garbage from the lower adjacent aural carrier signal that the customers can no longer *watch* the herringbone-laced desired channel picture.

Our suggestion is that you introduce your sweep or broadband noise source *at the input to the processor* itself, ignoring for all measurement purposes the equipment ahead of that point. Make a notation that *this is how* you conducted this test in your test logging forms.

Now suppose you find that your processor *alone* tilts the response so badly within the —0.75 MHz to +4.0 MHz region that you cannot meet the +/— 2 dB spec? Then what?

First take your sound level (aural level) control and crank it so the aural carrier level comes up, way up, as far as it will go. Note what happens to the sweep / noise trace. If it has changed within the —0.75 to +4.0 MHz visual carrier/ visual information region, slowly turn the aural carrier back down to the point where the trace (hopefully) comes *within* the +/— 2 dB spec. Now disconnect the test signal sweep or noise source and re-connect the antenna signal. Measure the level present of the aural and visual carriers. You will probably find that your aural level is now *too high* to meet the —13/17 dB spec of 76.605 (a) (6).

Mark the dial so you know where the knob points when you are *flatness-spec-legal* and disconnect the antenna again, replacing it with the noise/sweep source. Now continue cranking the level on the sound carrier until you notice that the high end (i.e. at the upper +4.0 MHz point) starts to fold (typically down indicating a reduced response at that point). See how far it folds down when you crank the aural carrier all the way down. Make notes of all of this and then rehook everything back up to the antenna (and adjust the sound carrier for —13/17 dB) and report the sick processor to someone who can realign it.

Many heterodyne processors have difficulty bringing the aural down without prematurely *rolling off* the visual in the +3.0 to +4.0 MHz region. This is an alignment problem, and hopefully it can be solved by someone with expertise in this area. If you have a strip amp system or other on-channel system that does not heterodyne convert to I.F., you are presently controlling your aural carrier level with an external (or built-into-the-strip) sound trap. These little devices are tricky at best. They can roll *into the sound carrier* region from *either* side; that is, they can track through the visual carrier region *up into the sound*, or they can track *down into the sound* from the upper adjacent channel. If you roll *up* into the sound carrier region from down inside of the desired channel picture, and you tune so the trap has the aural down —13/17 dB, chances are pretty good that in doing so you are rolling off the in-channel *visual* information between +0 and +4.0 MHz pretty badly. The solution to this is to take the external (or built-in) sound trap *up above* the channel and then bring it *back down* into the channel from the upper adjacent channel. If your trap uses a capacitor tuning system, this means you go *from* a wide-open (i.e. rotor and stator on capacitor maximum disengaged) position *to a* partially closed position. This takes you from *Up* to *Down* in frequency. If your trap uses a slug-tuned coil arrangement, pull the slug up *OUT* of the coil and *then* go back down into the coil with the slug. That takes you from UP in frequency to DOWN in frequency, and it assures that you approach the sound carrier from the "proper direction."

If all else fails, buy a new processor.

> "*(9) The ratio of visual signal level to system noise, and of visual signal level to any undesired co-channel television signal operating on proper offset assignment shall not be less than 36 decibels. This requirement shall be applicable to: (i) Each signal which is delivered by a cable-television system to subscribers within the predicted Grade B contour for that signal, or (ii) each signal which is first picked up within its Grade B contour.*"

At the present time, although it may change at any time (only fools will guess what the FCC will do next), part of *this* measurement *is suspended* for all *grandfathered* systems. But not for systems constructed after March 31, 1972. If that fails to make any sense to you, join the crowd.

Basically, if you are not picking up a signal from within its predicted Grade B contour, you can ignore this measurement for that channel. If none of your channels are Grade B (or better), you can ignore this measurement for *all* of your Class I (off-air) channels.

If you are getting a microwave signal, and it is starting off at an off-the-air point within the Grade

B contour for the station (i.e. this is where it is first demodulated and dropped into a microwave system), then you have to be concerned about making spec with that channel even though you may be several hops of microwave away from the pickup point; and it is out of your control anyhow.

What do you do if you have a Grade B or better signal with a co-channel beat that is not 36 dB or more below the desired signal?

(1) Pray that the weather changes;

(2) Go fishing and come back another day for your tests.

Or you *could* fix the problem. If you have co-channel, you have an antenna problem; at *wherever* the pickup point is for the off-the-air reception. CATJ has covered antenna system designs and co-channel elimination (see September CATJ, Page 12) repeatedly. We won't do it again here at this time. We *do* suggest that if you have co-channel on a signal within its B contour, you probably have done a poor job of planning your antenna-receiving array. We all expect *some* co-channel *some* of the time, and we have every reason to believe that the FCC, which reads CATJ closely, is *finally* beginning to realize that this *is* an occasional problem. So *we expect* them to be reasonable with us when it occurs now and again. On the flip side of that record is your obligation to see that co-channel is not an *ordinary kind* of picture degradation.

There is one other out: one fellow told us he was planning to tell the Commission that his co-channel *was desired*, not undesired! (He said *his* customers were so accustomed to co-channel on their own antennas that they are not at home or comfortable unless he keeps *a little* in there all of the time!)

> "*(10) The ratio of visual signal level to the RMS amplitude of any coherent disturbances such as intermodulation products or discrete-frequency interfering signals not operating on proper offset assignments shall not be less than 46 decibels.*"

As with the previous section, this one also has *also* been suspended for all *grandfathered* systems (built before March 31, 1972). Only the new systems must make this measurement (and comply) at the time. Although, again, this is a temporary suspension, and as soon as the Commission can figure out for us how we can all afford reasonably good-quality spectrum analyzers, we *can expect* this one to come back.

POST 72 SYSTEM ONLY SPEC

About the only known way to measure whether co-channel source or atmospheric-plus-system noise is no less than 36 dB below the desired signal voltage is with a spectrum analyzer. Grandfathered systems have had this measurement postponed, but systems constructed after March 31, 1972 are still supposed to be making this test, this year.

Note that this test applies only to signals first received within the predicted Grade B contour of the television station; if you are outside of the Grade B contour, you do not make this test.

Basically, we are herein obligated to see that no signals, generated within the system (i.e. IM) or introduced into the system from external sources measure any stronger than —46 dB relative the visual carrier level of the channel *assignment* these IM products or interfering external signals fall into.

This problem, if you have it, is good for a book-length feature all by itself. IM products indicate poorly designed amplifiers, or a poorly designed set of amplifier spacings and input/output levels, or all three. Or it may *only* indicate a cascade that has gone too far; i.e. you have stretched an amplifier type designed for a 20-amplifier cascade to one operating 40-50-60 (etc.) deep. The solution is to replace the amplifiers, respace the amplifiers, re-level the amplifiers, or some combination of these. It won't be cheap, whichever course you take.

Discrete-carrier signals can come from virtually any source (did you hear the one about the CB'er who plugged his 100-watt linear into his cable drop?). One of the most common sources is the garden-variety TV receiver; radiating its own local oscillator backwards into the system through the set-serving drop cable, and from there it travels *backwards* toward the headend until it runs into an amplifier output port (which usually stops it dead) and *downstream* until the end of that particular feeder line. *The TV set is at fault*. . . but *you* are a co-defendent in the eyes of the FCC for providing the get-away vehicle.

Any discrete frequency carrier is a potential signal beat source. We covered this in some detail in the May 1974 issue of CATJ (RFI—Sources and Cures). First isolate the section of plant involved, and then proceed to disconnect drops, feeder lines, and feeder-line splits a line at a time to isolate the exact point where the carrier is getting into the system. When you have it isolated, find the source of the signal and turn it off.

IF YOUR SYSTEM DOES NOT MEET SPEC— then what? How severe a problem are you facing to have your system into form for technical compliance with the provisions of 76.605 (a) 1-12 by March 31, 1977? While we look at other measurement problems and techniques associated with 1975/76 Compliance Measurements in this issue, and again in January, here is a review of what it means step by step if your system is not up to spec. It may cost less than you suspect to come up to spec. Then again, it may cost more!

If the beat starts at the headend and is visible throughout the whole plant, your problem is either coming in through one (or more) of the headend antennas or is being generated in the headend itself. Start by turning off, and then back on, one channel at a time at the headend. If the carrier (beat) persists, *turn them all off*, then turn them back on *one at a time*. At some point the beat will

reappear. It may be a local oscillator in a UHF to VHF converter, a local oscillator in a heterodyne processor, a subharmonic or harmonic of a pilot carrier generator. It may even be an oscillating stage in a preamplifier, taking off (i.e. oscillating) on its own. It can be found, and it can be cured. Although you may well spend quite a little time finding it.

"(11) *The terminal isolation provided each subscriber shall be not less than 18 decibels, but in any event, shall be sufficient to prevent reflections caused by an open-circuited or short-circuited subscriber terminals from producing visible picture impairments at any other subscriber terminal.*"

In simple language, no matter *what happens* to one outlet on the system, it shall not cause ghosts or herringbone beats on the picture of any other outlet on the system. *Period.* If it does, regardless of whether you have the indicated 18 dB isolation or even 28 dB isolation, *you will fix it.*

Check the DT serving the home. Change it out. Check the pressure tap serving the home. Change it out. Check the two-way splitter hung under the eaves of the home, and feeding signal to the home next door. Is it a hybrid splitter? If not, change it with one that is.

"(12) *As an exception to the general provision requiring measurements to be made at subscriber terminals, and without regard to the class of cable-television channel involved, radiation from a cable-television system shall be measured in accordance with the procedures outlined in 76.609 (h) and shall be limited as follows:*

0 to 54 MHz	*15 microvolts per meter at 100 feet*
54-216 MHz	*20 microvolts per meter at 10 feet*
216-up MHz	*15 microvolts per meter at 100 feet.*"

Radiation test will be covered in some detail in the January issue of CATJ. If you have a radiation problem, it needs to be solved.

THREE WAYS TO MEASURE CABLE CHANNEL FREQUENCIES
(Including One No-Test-Equipment)

This year, on or before March 31, 1976, all systems (including grandfathered) systems must complete a series of test measurements which include for the first time for grandfathered systems measurements of cable channel operating frequencies under certain circumstances.

Section 76.605 (a) (2) states: "(2) *The frequency of the visual carrier shall be maintained 1.25 MHz +/− 25 kHz above the lower boundary of the cable television channel, except that, in those systems that supply subscribers with a converter in order to facilitate the delivery of cable television channels, the frequency of the visual carrier at the output of each such converter shall be maintained 1.25 MHz +/− 250 kHz above the lower frequency boundary of the cable television channel.*"

First of all, who does *not* have to make frequency measurements this year? And, are there *some channels* requiring measurements, and some channels that *do not* require measurements?

Measurements are required on:

(1) All cable channels programmed with off-air television signals, regardless of whether these channels are received directly off the air at the cable system headend, or delivered to the system via microwave (and hence placed on the system via a modulator); or delivered to the system at video/audio from the TV station *except*;

Measurements are *not* required on:

(2) Any non-broadcast cable channels (i.e. local origination channels, pay channels and others non "broadcast" through the air to the general public);

(3) Any broadcast cable channels where your system utilizes either an *on-channel heterodyne processor* (i.e. 2 in, 2 out, using the *same* local oscillator to mix the input [off-air] signal down to I.F., and then back up to cable RF);

(4) Any broadcast cable channels where your system utilizes *strip amp headend processing* where no conversions are employed.

If that still confuses you, measurements *are* required when:

(5) You process with a *channel conversion* heterodyne processor (i.e. 6 in, 9 out to cable);

(6) You process *any* UHF channel to any VHF channel, regardless of whether you employ an external UHF to VHF converter or a heterodyne processor with a UHF (crystal or tunable) input and a VHF output;

(7) You process even with a strip amp, but stick a *VHF to VHF conversion* in someplace (i.e. ahead of or after the strip amp);

(8) You headend demodulate to baseband video and audio, or, take a microwave video/audio feed and re-modulate in your headend (even if you re-modulate out on the cable on the same RF channel that the signal began on).

The requirement that you *measure* the operating frequency of your cable carriage channel applies anytime your equipment, or other cable-related equipment ahead of you employs its own (crystal controlled) oscillator to generate the RF cable carriage signal; any RF oscillator that is not situated inside of the "clean" environment of a federally licensed TV broadcast station.

Because there are few CATV systems that carry *only* on-channel signals employing *only* non-conversion equipment, the presumption is that of all measurements required to date, this year's frequency measurements are likely to cause the greatest number of systems the greatest number of new problems. Accordingly, we are showing three separate methods of satisfying the frequency measurement requirement, with some advice directed at getting yourself back on frequency in those situations where you find you are outside of the 25 kHz (+/—) deviation permitted.

The No Test Equipment Approach

The system with only a couple of channels that require measuring is something less than enthusiastic about the capital outlay required to measure frequency. There are a couple of "no-test-equipment" approaches to frequency verification; we'll cover one of them here.

The *rules* do not address themselves to *techniques* for measuring frequency (76.609); the assumption being that frequency measurements do not require detailed instructions. The rules do not, therefore, state (or interpret to mean) that you *actually must measure the frequency*. If you can figure out *how* to determine that your cable signal is "maintained 1.25 MHz +/— 25 kHz above the lower boundary of the cable television channel" without hauling in a frequency measurement test set, more power to you.

The deviation permitted is +/— 25 kHz. This is slightly more generous than is allowed to the TV broadcast stations themselves. Recall that television stations are assigned offset operating frequencies. For *each channel* there are actually *three operating frequencies* (for the video carrier; the aural carrier as broadcast is automatically 4.5 MHz above the visual). These are known as "plus offset", "zero offset" and "minus offset". Stations operating on plus offset are assigned 10 kHz *above* the nominal channel operating frequency. Stations on "zero offset" are assigned the nominal operating frequency. Stations assigned "minus offset" are assigned 10 kHz *below* the nominal operating frequency. On channel 13, plus is 211.260 MHz; zero is 211.250 MHz, and minus is 211.240 MHz.

Thus there is a +/—10 kHz (20 kHz total) *operating span* for TV broadcast transmitters. Cable carriage is permitted anyplace between 25 kHz *low* (211.225 MHz for channel 13) and 25 kHz *high* (211.275 MHz for channel 13). The 25 kHz +/— variation tolerable for cable is our "window."

To insure that your system meets the requirements of 76.605 (a) (2), you must satisfy yourself that you are *within that window* with your cable carriage signals. See Diagram one.

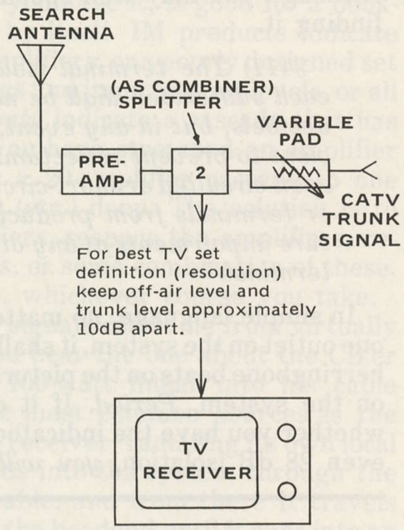


DIAGRAM 1

If you know the assigned operating frequency of an off-air TV signal, and you know how to mix it with your cable carriage signal on the same channel, and, you also know how to interpret the beat between the two signals *as displayed on a television receiver*, you *can* satisfy 76.605 (a) (2) *without* any frequency measuring equipment. The requirement is that *you know* you are not outside of the +/— 25 kHz window. The requirement is not that you know the *actual* cable operating frequency.

Let's deal with the three requirements one by one.

(1) *Off-Air Frequency*—There are two quick references to locating the plus/zero/minus offset data for U.S. TV stations. One is the *Services Volume* of *Television Factbook* (pages 192-195 for 1974/75 edition). The offset assignments for Canada, Mexico are found on pages 202-205 in the same edition of *Factbook*.

The second source is the *CATJ W.T.F.D.A. TV Station Guide*. (Note: This CATJ distributed publication is available for $6.50 each from CATJ, 4209 NW

23rd, Suite 106, Oklahoma City, Ok. 73107.)

(2) *Mixing Two Signals*—See Diagram 1 here. Note that the search antenna, with a pre-amplifier if required, is used to develop your off-air reference signal. A headend trunk line signal tap (or a test point tap out of an individual channel processor) provides the cable carriage signal. By adjusting the trunk/headend signal on channel to balance with the search antenna provided signal on the cable carriage channel, you display the *beat product of the two signals on a television receiver.*

It is worth noting here that if you have a decent search antenna with rotor, there are very few areas of the United States east of the Rockies or along the west coast where you cannot find *some sort* of off-air signal on virtually *every VHF* channel. You don't need *much* signal; even 20-30 microvolts (i.e. as low as —35 dBmV) will do. The off-air signal is simply a *reference* signal, to beat your cable carriage channel signal against.

(3) *Interpreting Beats*—When two signals mix in a television receiver, on the same channel, they provide a *visual beat pattern.* The type of beat pattern they create is a direct function of the *frequency separation between the two carriers.* That is, if the off-air signal and the cable channel are within a couple of kHz of one another, one type of visual pattern is displayed. If the two carriers are 10 kHz apart, another (distinctly different) type of beat pattern evolves. If the two signals are 25 kHz apart, yet another type of beat pattern evolves.

Therefore, if you follow the procedures detailed here, and look at the TV screen to see the beat pattern, you should be able to determine whether you are within the +/—25 kHz tolerance required by 76.605 (a) (2).

Photo one shows two signals 3 kHz apart. We could have shown two carriers exactly zero beat (i.e. on the same frequency) but that photographs poorly. Note in photo one that we have broad (black) beat bars. The bars are the beat "note" or mix *product* created by the two slightly-frequency-offset carriers.

Now when two stations are *exactly* zero-beat, there is *no* bar on the TV screen simply because there is no frequency difference between the two carriers to create a "beat". However, as the two frequencies start to move further and further apart in frequency, the bars begin to show up. First they appear similar to photo one; broad black (alternating with white) bands. Then as shown in photo 2, which shows two stations 5 kHz apart, the *number of bars multiply* (i.e. there are *more* of them). In photo three, the two carriers are 10 kHz apart and we have still more bars. In photo four the two carriers are 15 kHz apart, and so on until we get to the 35 kHz separation of photo nine.

If your (local) off-air reference signal is on a plus (or minus) offset you know they are automatically 10 kHz above (or below) the *nominal* operating frequency. Now if you are 25 kHz offset in the opposite direction from the nominal operating frequency (i.e. zero offset), the beat produced would be a 35 kHz beat (10 offset +25). The station would be operating properly, and so would your cable carriage channel. Both of you would be "legal" respectively.

There are a couple of additional factors that must be mentioned in employing this technique. First of all, you may well find that your search antenna produced off-air signal has a bunch of co-channel interference (i.e. beats) *in it.* If you are so located that with your search you can locate two or more off-air signals, they will produce their own "beat pattern"; *before* you even add in your own local cable channel. Whether you use a "plus", "zero" or "minus" offset off-air reference signal is relatively unimportant. Therefore you should rotate your search until you find the *cleanest* off-air picture possible (i.e. the one with the *lowest* amount of off-air co-channel interference in it), even if the signal received is not very strong at that point. The *off-air* beats *will* confuse you, although you *can* work through them if you keep your head about you. Then be sure you know *which* station you are referencing against. Wait for a station break if you have any doubt at all, so you can "test log" the exact station you used for a reference in your test results workbook. If you happened to *think* you had a "plus" offset station, and you found you had a 30 kHz beat with it on your cable channel, *when in fact* you were looking at a *zero* offset station, then your 30 kHz cable carriage offset *would be* out of tolerance by 5 kHz. Be very sure of the identification of the station you are referencing, and, be sure of its assigned offset. And, log it by call letters in your test workbook.

You will find the best TV screen display occurs when the two signals (i.e. off-air and cable channel) are *about* 10 dB apart. This is *not* critical, but the best display is in this region. The *actual* level to the TV set is *not* important at all; it is probably best to keep it *down* in the —10 dBmV region. Either signal (i.e. off-air or cable) can be the *stronger* of the two, although typically the cable carriage channel will be the stoutest.

Finally, if you find *you are out of tolerance* (i.e. beyond +/— 25 kHz), what can you do about it?

Correcting for the problem is a function of the *type of conversion* you are using in your system. The conversion oscillator (or the local oscillator in a local modulator) is the culprit. If the oscillator is crystal controlled (virtually all are or must be to maintain the type of tolerances

Continued on page 22

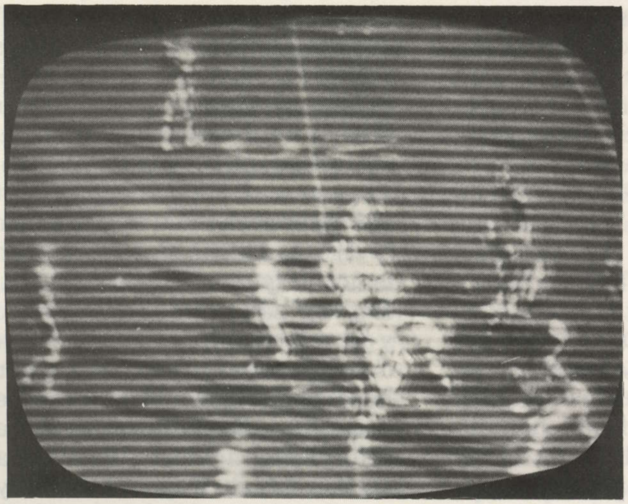


PHOTO ONE — a 2.82 kHz beat between the off-air carrier and the cable test carrier.

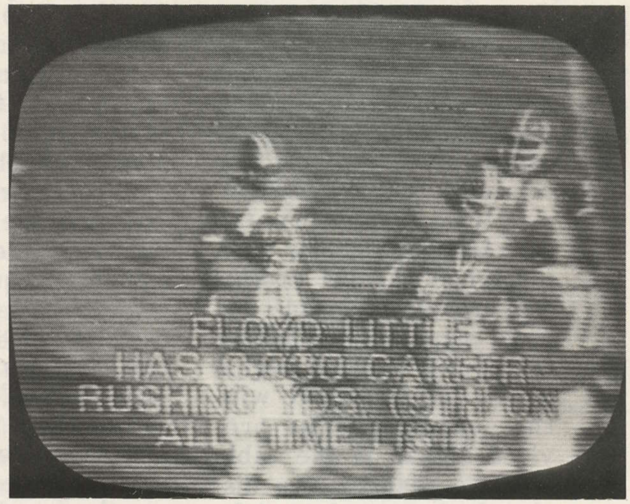


PHOTO THREE — a 10.0 kHz beat.

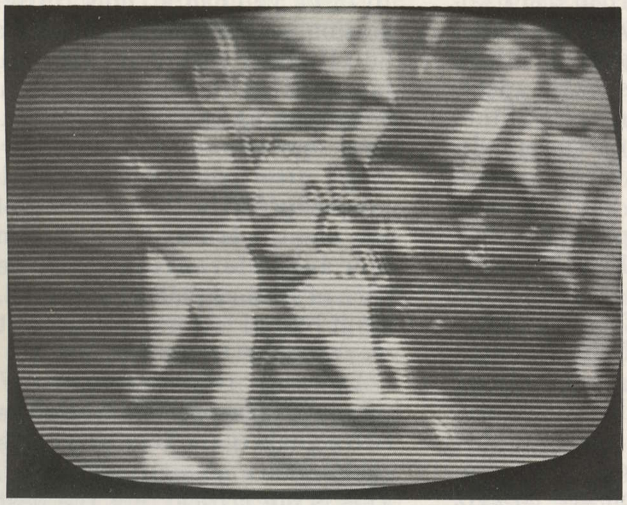


PHOTO TWO — a 5.0 kHz beat.

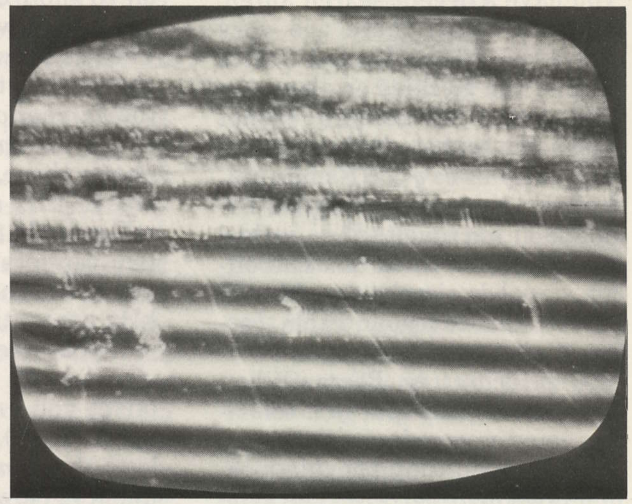


PHOTO FOUR — a 15.0 kHz beat; note it appears to be "near zero" with the main carrier; when in fact it is near zero with the first 15.750 kHz lower sideband.

VISUAL FREQUENCY TESTS

CATJ has conducted a series of measurements representing we believe a wide variety of co-channel interference situations, in our CATJ lab. Our purpose was to develop a technique whereby, with reasonable degrees of accuracy a system operator could create a set of ''visual'' TV screen tests to ascertain the extent of compliance with cable channels operating +/— 25 kHz from the nominal assigned broadcast channel.

The type of co-channel display (i.e. the interference pattern) depends to a large extent on the (1) **relative levels** of the two (or more) ''beating'' signals, (2) **modulation format** present between the two carriers, and (3) the **size screen** the observer is utilizing for his ''tests''. Based upon our extensive tests, we issue the following caveats about your duplicating these tests on your own.

(1) Where possible, keep the off-air signal and the cable channel signal within 10 dB of one another (either one can be the stronger of the two);

(2) Where possible, kill any modulation on the cable channel carrier, by disconnecting the modulation source (on a modulator), or with a heterodyne processor, switching to the standby carrier (if you **know** it to be of the **same** accuracy as the heterodyne output) or, substituting a zero-beated unmodulated (AØ) carrier as an input to the heterodyne processor **in place of** the normal cable carriage RF signal;

(3) Where possible, perform the tests on a 17/19 or 21 inch receiver; smaller screen sizes are more difficult to ''read''.

In the TV screen photos shown here, CATJ ran a signal generator (Measurements 950) into a two-way splitter, driving a frequency counter out of one leg and through an attenuator the TV receiver on the opposite leg. The signal generator carrier was held around 10 dB **below** the desired off-air signal.

The off-air test station was on channel 2, and it was measured with a Mid State Communications SP-1 and CM20M as operating on 55.260010 during the test sequence. This is a 10 kHz plus offset. The signal generator had a natural downward drift at around 10 kHz per hour, so we set it above 55.260010 and allowed it to drift down through ''zero beat'' (55.260010) and on down to a point 35 kHz below that frequency. The photos shown depict the beat pattern that resulted.

Notice that the **first photo** is of a 2.82 kHz beat; not a ''zero-beat'', because a zero beat produces a pattern that is either not discernable or it consists of a couple of waivering ''vertical'' **wide** bars. As the ''beat goes on'' (i.e. drifts further and further from the channel 2 off air signal) the number of horizontal ''bars'' in the beat increase. Theoretically, when you get to a point 30 kHz below the nominal off-air signal frequency, you **should have** twice as many bars or horizontal ''screen lines'' showing as at say 15 kHz. However, because of the 15.750 (kHz) sidebands in the TV transmis-

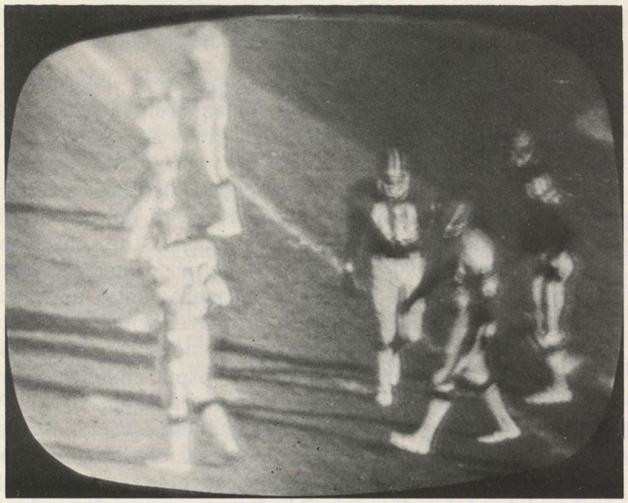


PHOTO FIVE — a 15.750 kHz beat (at 55.244260) has the looks of a zero beat with nearly vertical lines.


PHOTO SEVEN — a 25 kHz beat has definite appearance of moire pattern, although horizontal beat bars predominate.

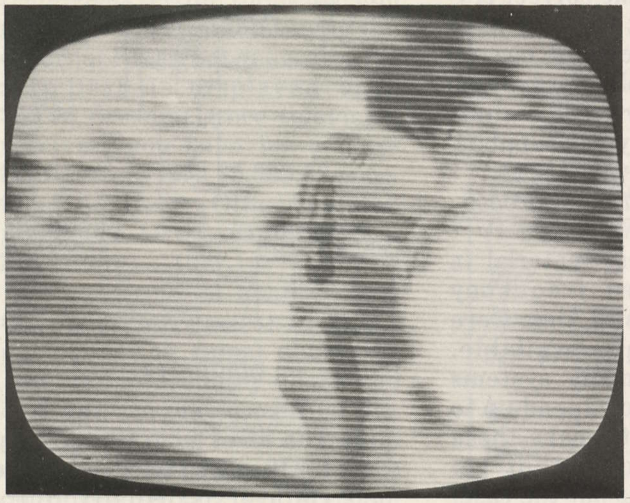


PHOTO SIX — a 20 kHz beat; note start of moire pattern with horizontal beat bar lines.


PHOTO EIGHT — a 30 kHz beat nears the second lower sideband at 31.500 kHz below the main visual carrier.

sion, the signal generator wanders into being near or exactly ''zero beat'' with these 15.750 kHz ''sidebands'' everytime it approaches the carrier frequency minus (or plus) 15.750 or 15.750 x2, x3, etc. Thus rather than having a **clean** ever increasing number of horizontal ''beat bar lines'' as you wander further and further from the off-air signal carrier frequency, you move in and out of 15.750 kHz sidebands and **each time** you do you have a zero-beat-like pattern that mixes with the real-of-interest beat; the one between your off-air signal and your (cable channel) locally generated frequency. This causes you to have **two beats;** one that is between the cable frequency and the main TV carrier and **the other** between the cable frequency **and** the **nearest** 15.750 kHz sideband signal.

If this were the end of the line, visual testing would be a sham because you could actually think you were zero beat with the main carrier when in fact you were zero beat (or near it) with only a 15.750 sideband.

Fortunately for everyone involved, as we move further and further from the main carrier frequency, the distinctive pattern on the TV monitor (i.e. read out device) screen changes. During the interval from the main carrier down (or up) to the **first** 15.750 kHz sideband (which falls at 55.260010 minus 15.750 and 55.260010 plus 15.750 in our example) we have clean appearing horizontal lines (see photos). As we move into the next sub-region (55.260010 minus/plus 15.750 to 31.500) the pattern begins to take on a slightly mottled appearance. The horizontal beat lines still predominate but there is the **slightest hint** of diagonal (**top** left to **bottom** right angular) lines **also** in the picture. This you can see on a 17'' up receiver screen. Therefore if you have **clean** horizontal only lines, you know you are within the **first** sub region or between the visual carrier frequency and the first 15.750 sideband.

As we move into the next sub region (55.260010 minus 15.750 to 31.500) the hint of a moire pattern (i.e. cross-hatch) begins to appear. If you have this weak moire pattern showing, you know you are in the 15.750 to 31.500 region away from the main carrier.

Finally as we move into the third sub-region, or 31.500 to 47.250 (kHz) away from the main carrier, the moire' pattern (i.e. cross-hatch) is very **pronounced.** The screen has no **easily** defined horizontal **or** diagonal lines; both distinctive line sets **blend** into a waivery, washed out (i.e. watery) format that seems to hang as a ''film'' over the picture. If you have **that pattern** apparent, and your off-air station is assigned to the zero offset, you are for sure out of the kHz (+/—) spec region.

Getting the hang of reading offsets may take you a little time and practice. If your modulator/heterodyne processor has any way to adjust the exact operating frequency (i.e. such as a trimmer capacitor across the oscillator frequency), you can tweak upon it until you have a pattern similar to photo one here, and be relatively assured you are within the +/— 25 kHz offset tolerated by the FCC rules.

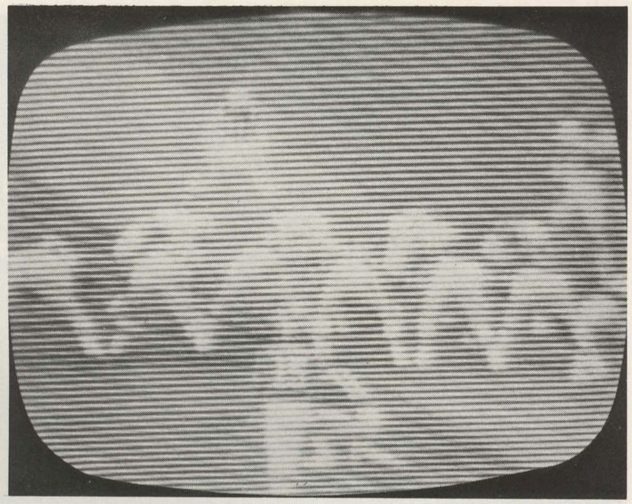


PHOTO NINE — a 35 kHz beat has distinctive moire pattern to it, indicating multiplicity of "beats" between cable generated carrier signal and main carrier plus sidebands.

SUBSCRIBER SET CONVERTER MEASUREMENTS

Systems employing subscriber converters theoretically must provide two separate sets of measurements; the first set following the general outlines given here, nominally done at the headend.

Then **where** there are subscriber converters in some or all of the system, and where the converters deliver off-air signals (i.e. **not** locally originated channels), the subscriber location plant measurements must be performed **inclusive** of converter output frequency measurements, on those channels delivered through the converter which originate as broadcast TV signals. However, the measurement in this case is for a single channel (i.e. the output channel of the converter only, as it delivers the converted signals to the TV receiver). Test log forms should include measurement data for the indicated output frequency(cies) of the converter employed, as well as the subscriber converter make, model, and serial number (for possible future cross referencing).

required), the crystal in the oscillator must either be "walked" or "changed out." If your oscillator in the conversion package has a trimmer capacitor *across* the crystal, the crystal can probably be *fine-tuned* (i.e. walked up or down in frequency). Using the test set up shown in diagram one, simply tweak upon the crystal trimmer capacitor until the TV screen *displays a zero-beat pattern* (one or a few broad lines); *similar* to that shown in photo one.

A word about *changing out* oscillator crystals. Crystals are supplied by crystal manufacturers according to the design parameters of the oscillator circuit. Merely ordering a 55.250 MHz crystal for a channel two modulator will *not* solve your problem. No crystal supplier can supply the proper crystal, one that will operate *on frequency in your oscillator circuit*, unless the crystal supplier knows the type of oscillator circuit your units employs and the crystal capacity required. Most original equipment manufacturers supply this information in their manuals; and no reputable crystal supplier will sell you a crystal unless they know at the very least the make, model and vintage of your particular piece of equipment. Then from their own files, *if* they find they have the original manufacturer supplied oscillator data, they *can* supply you with the *correct* crystal. Short of that you may have to go into the oscillator circuit, and draw a complete *schematic of the oscillator* with values noted, for the crystal supplier.

Signal Gen/Counter Approach

Most CATV test material in print approaches frequency measurements as if this were the only technique available. Fortunately for many systems that would have to expend up to $800. / $1,000.00 to make these tests for the equipment required here, this is *not* the case.

See diagram 2. This approach utilizes the same general approach outlined in the no test equipment approach; except rather than reading out from the TV screen the beat created, the TV screen is utilized to set up a close-to-zero-beat situation as a reference. Then the signal generator utilized to provide the beat is read for frequency on a frequency counter.

The advantages to this system are that it is fairly fast, and precise.

(1) Set equipment up as shown in diagram 2.

(2) The signal generator drives (through a 2-way splitter) both a counter and (through a variable attenuator and another splitter) a TV receiver.

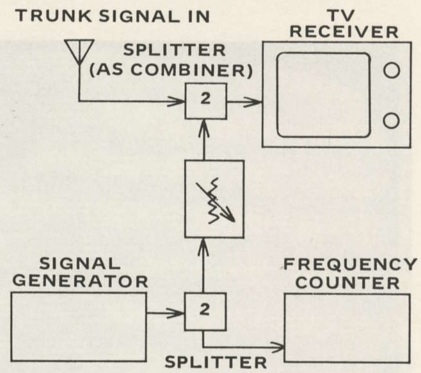


DIAGRAM 2

(3) The level from the generator required for driving the counter is usually quite *high* (exact spec depends upon the trigger-input-level required for the counter). On the other hand, the level required to produce a "zero-beat" pattern with the trunk/headend processor input signal in the top splitter (diagram 2) is considerably lower. Thus the requirement for the variable attenuator.

(3) While watching the TV screen for signs of a beat pattern, the signal generator is walked into the channel until something approaching a zero beat is produced. At this point the signal generator freezes and you turn to the counter and read the exact output

frequency of the signal generator at the point where you have an exact or near zero-beat showing on the TV screen. This frequency is logged in your test-log workbook *as the cable operating frequency* of the cable channel. By simple math, you determine the kHz *difference* between the *nominal assigned frequency* and the *cable carriage channel.*

If you are within +/— 25 kHz, you are in business. If you are outside of this permitted tolerance region, you are back in the oscillator tweaking or crystal change-out business.

There is a modification of this approach which purists will like; it involves substituting a spectrum analyzer for the television receiver. Rather than tuning the external RF signal generator for zero-beat as displayed on a $69.95 discount store television receiver, you tune for a zero-beat pattern on a $5,000.00 spectrum analyzer. Otherwise the procedure is the same as outlined here.

If you have a quality spectrum analyzer, you can even *forget about* the signal generator /counter and simply place the S/A into narrow resolution display where you have a *calibrated* horizontal scale. If you are operating 10 kHz per division, then you can *read* with sufficient accuracy the *frequency offset* between the off-air signal and the cable carriage channel.

Strip Mod/Counter

Finally there is a package of equipment designed *primarily* for measuring CATV cable carriage frequencies; *Mid State Communications* (40 N. Seventh Avenue, Beech Grove, Indiana 46107) introduced several years ago their SP-1 and SP-2 signal processors, and a companion 500 MHz counter the CM20M.

Unfortunately for those who *already* own counters, you can*not* simply load the TV spectrum into a counter box and read out the frequency. In fact, you cannot even load a *single* channel processor into a counter and read the visual carrier frequency.

The standard TV signal has a multitude of carrier signals present; a function of the main carrier, the modulation sidebands (which are energy sidebands), the 15.750 kHz sync and so on including the aural carrier. The poor counter, *even when* presented with a single channel of signal(s) from a high level source such as a headend processor simply goes wild; counting one energy center one count and another related *but different* energy center the next count. The result is a wildly erratic count that every now and again *does* count the visual carrier frequency, but in between it may count several hundred *other* related energy centers.

Thus the counter needs to have pre-selected from the morass of energy centers present *only* the visual carrier frequency. Then it needs to have the modulation sideband products stripped from the carrier so that all that remains for the counter to "see" *is the visual car-*

rier frequency.

The Mid State SP-1 (12 VHF channels) and SP-2 (12 VHF channels plus 12 other channels such as mid and/or super band) Signal Processors *do just this;* pre-select the visual carriers, and then strip them sufficiently of the modulation product so that in the end there is predominently only a carrier remaining. Then that carrier is sent along to the CM-20M counter. See diagram 3.

Other than the Mid-State "box" (SP-1 or SP-2), an operator *could* accomplish the same type of pre-selection and stripping on his own by approaching the prolem much in the same way Mid State did. A *very narrow* passband single channel amplifier is centered on the visual carrier frequency. The level of the visual carrier signal is purposefully amplified to the point where the input level to the final amplifier stage in the pre-selector processor amplifier is too hot. That is, the output capabilities of the output amplifier stage are *exceeded.* This causes the final stage to go into a form of limiting, which is not dis-similar to what happens when you run a line extender at +60 dBmV output (when it is *rated* at +48 dBmV maximum output). The sync signals clip or limit first, followed further up the output level ladder by the video modulation limiting. If you overdrive the stage *far enough,* the stage itself clips or limits-out the modulation and sync information present. *All that remains is the carrier,* and whatever amount of modulation plus sync product is left at the point where you stop limiting.

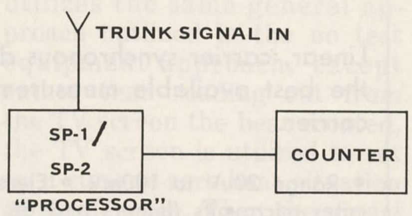


DIAGRAM 3

In effect, you strip the carrier of the modulation product.

Of course the SP-1 (12 channel) has several other features going for it; such as 12 channel turret tuner selection, a 4.5 MHz inter-carrier output for measuring the aural offset frequency, a hum-mod detection output for making the hum mod measurement, and so on. We'll talk more about this unit in the January CATJ as we go through the balance of the tests involved this year.

On the *counter side* of the package the primary function that *may* be overlooked is choosing a counter that has a *long time constant* option for the "gate time". In making FM (carrier modulated) measurements, such as the 4.5 MHz aural carrier, it is important that the counter *gate* or average the long term (relatively speaking) nominal frequency. Because the FM carrier swings under modulation, at any given instant it *may* measure several tens of kHz higher or lower than the assigned frequency 4.5 MHz above the visual carrier. Thus in an *averaging* system, you look at the average of overall carrier swinging. Setting a counter to gate in the millisecond time range is a sure way to drive yourself up the wall wondering why the aural carrier is so far off of frequency and so random at that. The Mid State CM-20M companion frequency counter to the SP-1/SP-2 processor package solves this particular problem by providing a gate time range up to ten seconds in length. Without that option you would be forced to make your aural (inter-carrier) measurements during those brief seconds when all modulation of the aural carrier stops.

Summary

Not all channels must be frequency measured. Only those channels which are frequency converted between their *off-air* (i.e. as broadcast) channels and their *cable carriage* channels require measuring.

Measurements of frequency need take place at only *one* place in the system; the headend is the most convenient location as a rule. This is because with the exception of systems employing subscriber converters, the headend delivered trunk cable carriage channel frequencies are the same frequency signals as delivered to the subscriber set terminals.

DIRECTIONAL TAP TECHNOLOGY
(Hum Mod From A DT?)
AND CERRO DT REVIEW/CONTEST

Although the specific topic of "ghosts" does not appear in the FCC rule book for technical specs for CATV systems, there is the general *understanding* that any system that provides pictures to a subscriber which have "visible picture impairments" (76.605 [a] [11] dealing with subscriber isolation) is *probably* in violation of the general intent of the rules.

This month's CATJ READER CONTEST deals with approximately $150.00 in brand new hybrid directional taps, being provided by the people at CERRO Communication Products (P.O. Box 2026, Anniston, Alabama 36201). And because the single *most likely* cause of "visible picture impairments" for *a customer* is the selection you have made of a subscriber tap off device, we are taking this opportunity to review the basic technology and engineering that goes into *directional tap* usage, and, why without them in some (or all) subscriber tap off locations, you *may* have difficulty making technical compliance by March 31, 1977.

In 1963, when directional taps (DT's) first came into widespread usage, those who were selling or promoting the DT were most generally asked by system operators "Why *should* I use DT's?" And, "What is *wrong* with my pressure taps?"

Now some 12 years later when DT usage is almost universal, one still hears questions about the DT; only now we hear "What is a DT?" And, "How does it work? Why *do* I use it? What is *wrong* with my pressure taps?"

To understand why the DT has become so popular, it would be well to look at a couple of typical customer feeder line situations. The purpose here is to calculate the rationale behind both the pressure tap and the DT; and why one provides superior ghosting protection for the system.

In diagram 1 we have a typical feeder line situation with a pressure tap installed at the mid-way point between two extenders. The specifications for this system layout are as follows:

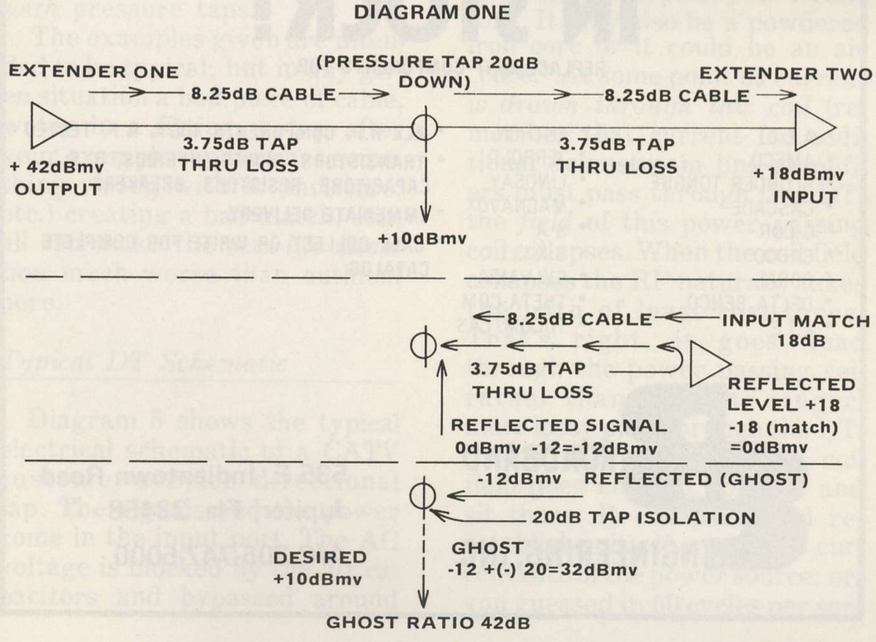
Extender Spacing—1,000 feet
Amplifier Output Match—16 dB
Amplifier Input Match—18 dB
Extender Output Level—+42 dBmV
Extender Input Level—+18 dBmV
Line Loading Assumed—7.5 dB between amps

Note that because the input match to the second extender is *not* perfect (none are; *all* have *some* mis-match), that not all of the +18 dBmV input level signal is accepted by the amplifier. The input match specified is 18 dB; which, with a +18 dBmV input level results in an input port reflection level signal of 0 dBmV (+18 dBmV minus 18 dB match). This 0 dBmV reflected level signal has only one place to go; back *down the line* towards the mid-way pressure tap.

Along the way, working backwards from the second extender input port to the customer mid-way pressure tap, there is 8.25 dB of cable loss and 3.75 dB of additional tap thru loss; a total of 12 dB of voltage loss. So the reflected signal arrives at the input to the mid-way pressure tap at an absolute level of 0 dBmV minus 12 dB or —12 dBmV (see diagram 1).

And the 20 dB isolation pressure tap allows that —12 dBmV reflected signal into the custo-

DIAGRAM ONE



mer's drop at —12 dBmV (*plus*) the 20 dB tap isolation (loss), or at a *level* of —32 dBmV. This is a ghost, at a ratio of 42 dB (—32 dBmV + the original +10 dBmV input signal).

A ghost at this level would be scarcely noticed by anyone; *but it is there.*

Now let's move on down the feeder line to another pressure tap; only this one is closer to extender number two; at a point only 3.3 dB of cable away (200 feet). The second extender match is still the same so the reflected level signal is still 0 dBmV. The path back to the pressure tap is now only 3.3 dB ofcable plus 3.5 dB of tap loss, so the ghost level at the input to the chosen pressure tap is now —6.8 dBmV (see diagram 2). The 14 dB of tap isolation takes us down to —20.8 dBmv for the ghost; and that produces a primary to reflected level signal *ratio* of 31.6 dB (—20.8 dBmV + the original 10.8 dBmV signal level). That ghost most anybody *would notice*, and as the good book says you have a "visible picture impairment".

Now if the drop in question was a real long son of a gun, and you tried to get through the long drop cable with say an 8 dB isolation pressure tap, your numbers

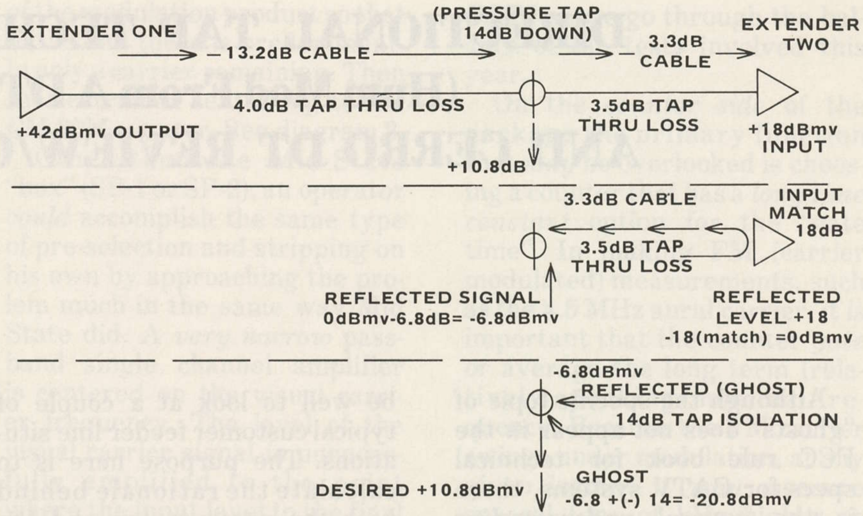
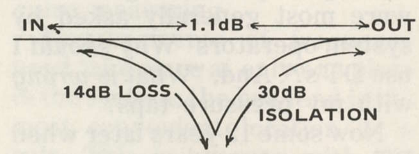


DIAGRAM TWO

would change again; for the worse. Now rather than 31.6 dB ghost ratio, we would have a primary to ghost ratio of 6 dB less; or 25.6 dB. Even old ladies in Hoboken will notice that kind of ghost!

So as you can see in our examples, when you get beyond the mid-way point between extenders, and move towards the next extender, you begin to create ghosting potentials which even first rate cable and amplifiers are not able to compensate for; if you are using a subscriber tap off device that does *not provide* sufficient reverse-path isolation. And where you can stand it the least, at the far end of a feeder line *just ahead of an amplifier*, is where it shows up the most.

Now in diagram 3 we have the basic directional tap building block. Note that it has the same parameters as a pressure tap; that is, it has thru-loss (i.e. loss as a result of signal tap-off), 1.1 dB, and, it has subscriber forward direction level isolation (14.0 dB). It also has one more thing; *reverse path* isolation; 30 dB in our example. This isolation works in two ways; it keeps signals coming back down the feeder cable (i.e. such as a ghost that is coming back at the device) from getting into the subscriber's drop (they do get in, but they go in down 30 dB). And, this isolation helps keep subscriber generated signals (i.e. receiver local oscillators) from feeding back into the down stream direction and getting into other subscriber sets (the subscriber generated signals also get into the feeder, but at 30 dB down).



DIRECTIONAL TAP

DIAGRAM THREE

This "miracle" is accomplished by a transformer network in the directional tap; the network senses the voltage (i.e. RF sig-

nal) in one direction and the RF current in the other direction. By proper phasing, the directivity is achieved.

tap (assuming an amplifier follows the tap and assuming its input match is 18 dB RTL or better).

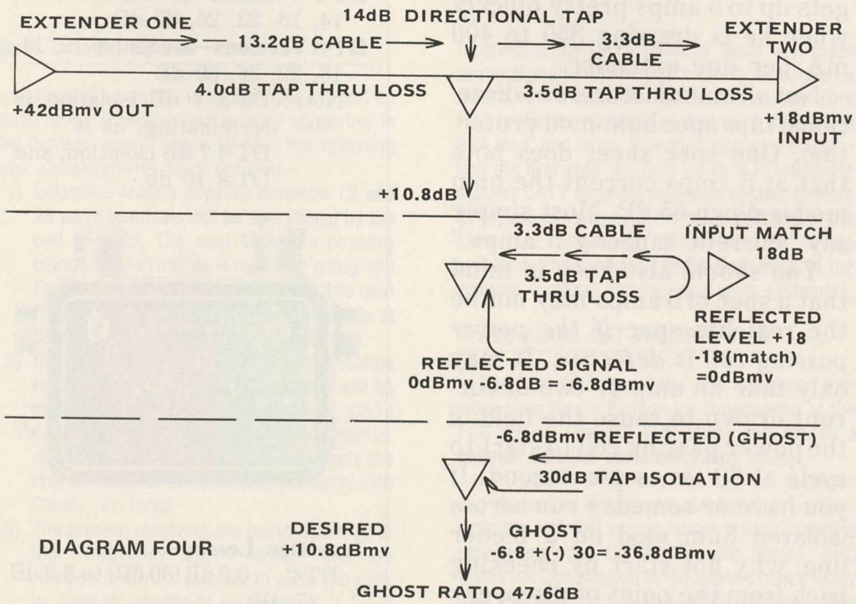


DIAGRAM FOUR

Now let's take the directional tap and insert it into our model system shown in diagram 2. See diagram 4. The number two extender input port parameters are the same and we still have a 0 dBmV reflected level signal bouncing back towards our DT. The cable and tap thru losses are the same, so we have a level of —6.8 dBmV appearing at the DT output port. However, because of the 30 dB directivity isolation in the DT, the reflected signal is now down from the —6.8 dBmV absolute value to —36.8 dBmV (6.8 + 30). With a + 10.8 dBmV primary path signal, the ghost *ratio* is 47.6 dB (—36.8 + the original + 10.8 dBmV drop signal level).

If there is any rule of thumb about using pressure taps, it is this. Where you are bound and determined to use these non-isolated devices (i.e. isolated in the sense of protecting your 'flank' against reflected path signals), use them *only* where your line level and tap loading calculations suggest that you can use 20 dB or higher values. As soon as you need less subscriber drop to feeder line level isolation than 20 dB you are into the potential ghosting region with a pressure tap.

There are other parameters here that should be obvious. If for any reason your amplifier input match is poor (meaning *under* 18 dB), you can quickly see how a relatively poor match can contribute to ghosting on taps near the amplifier. If you are at the end of a feeder line and you are *terminating* with a good match (i.e. 28-30 dB RTL), you can also see where this would help you prevent ghosting for further on down the line, perhaps almost to the end, *even with* pressure taps.

The examples given are intended to be typical; but in any given situation a bad piece of cable, water in a fitting, a tap after your example tap that has something wrong with it (moisture, etc.) creating a bad match, etc., all can make the *real life situation* much worse than outlined here.

Typical DT Schematic

Diagram 5 shows the typical electrical schematic of a CATV customer-service directional tap. The signals and the power come in the input port. The AC voltage is blocked by the .01 capacitors and bypassed around the directional coupler by the AC power pass coil.

The RF signal is coupled through the .01 capacitor and into the directional tap where it is fed to the output of the device with a minimum of thru loss. It is also fed to the tap, with the insertion loss via the tap path being considerably greater. After the tap-off the signal is coupled into a 2 or 4 way splitter and then to the output. Initially, most 4 output DT's utilized a *single* 4-way splitter. However, today most units have a trio of 2-way splitters. This is a more complicated approach, but it has the benefit of improved *tap to tap isolation* [remember 76.605 (a) (11) says that tap to tap or subscriber to subscriber isolation shall be 18 dB or better]; and a larger bandwidth.

DT Hum Mod

A directional tap can cause Hum Mod. And hum mod is another one of those FCC no-no's [76.605 (a) (7) says 5% maximum].

How can a *passive* device such as a tap cause hum mod? Glad you asked.

The power passing (AC) coil in diagram 5 exhibits a very high impedance to RF; it has to be that way to keep RF from passing through it. The power passing coil is typically a ferrite core. It may also be a powdered iron core or it could be an air "core." At some point *as current is drawn through this coil* (remember that current for additional downstream line amplifiers must pass through this DT) the *field* of this power passing coil collapses. When the coil-field collapses the RF naturally takes the path of least resistance. That's right, it goes dead through the power passing coil rather than take the longer, more lossy path through the DT.

Now the power passing coil field does not just collapse and sit there. It collapses, and reestablishes itself, at the AC current rate of the power source; or, you guessed it, 60 cycles per sec-

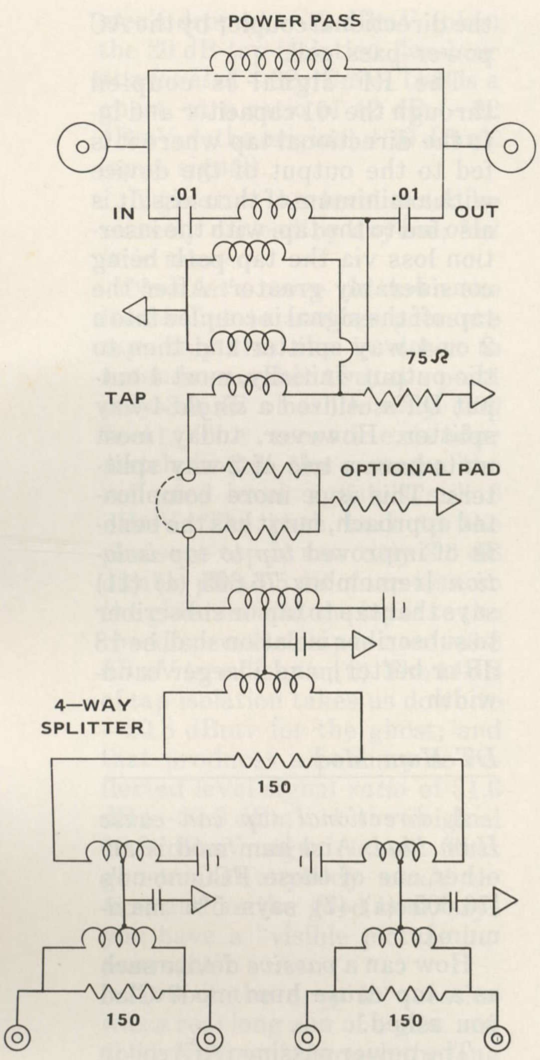


DIAGRAM FIVE

ond. So the collapse and re-structure of the power passing coil field happens at a 60 cycle rate. And that 60 cycle rate is in effect *a modulation form*, that appears on the RF signal from the location of that DT on down the line thereafter.

Hum mod by any other name is still hum mod.

Most directional taps are *current* rated. This does not *necessarily mean* that the power passing coil will fry or the board will melt if for some reason you exceed that current amount. It *may* be safe for power well beyond the current passing rating (typically 5 amps); but hum mod sets in at that "safe-spec" point; because of the afore-mentioned collapsing and re-structuring of the field around the power passing coil.

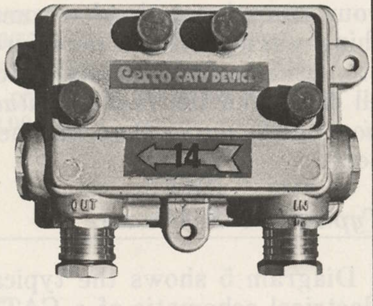
Now 5 amps may seem like quite a bit. But there are many plant layouts where with feeder line splits and what-all a fellow gets up to 5 amps pretty quickly when he is drawing 350 to 400 mA per line extender.

Not all manufacturers of directional taps spec hum-mod protection. One spec sheet does note that at 5 amps current the hum mod is down 65 dB. Most simply say "current capacity 5 amps."

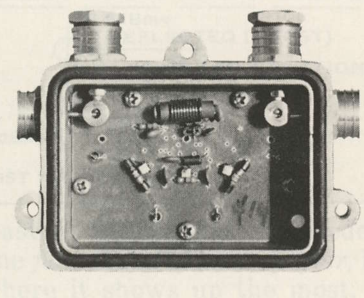
You should also keep in mind that a spec of 5 amps may not be the real life spec *if the power passing coil is defective*. It may only take an amp or two of current drawn to cause the field of the power passing coil to start to cycle at 60 times per second. If you have or someday run across isolated hum mod on a feeder line, why not start by checking back from the point of discovery towards the headend, looking at signal quality as you move backwards a DT at a time. At one location you will find that the hum mod is gone; which means the unit you checked out just ahead of that was bad.

CERRO DT SPECS

Frequency Range—5 to 300 MHz
Return Loss—20 dB (all ports)
Response Flatness—+/— 0.5 dB
Current Cpacity—5 amps
Isolation (Tap to Tap)—20 dB min, 25 dB typical
Isolation (Output to Tap)—25 dB min



Case—Cast Aluminum Alloy
Fittings Are—Siezed Center Conductor
Seals — Conductive gasket, weatherproof, radiation proof
Coding—Color coded tap values
Mounting—Strand or pedestal
DT-2 Versions—Available 4, 7, 10, 14, 18, 22, 26, 30 dB
DT-4 Versions—Available 7, 10, 14, 18, 22, 26, 30 dB
DT-8 Versions—Available 10, 14, 18, 22, 26, 30 dB
Note: DT-2 4 dB isolation is terminating; as is DT-4 7 dB isolation, and DT-8 10 db.



Insertion Losses—
DT-2. . .0.3 dB (30 dB) to 3.3 dB (7 dB)
DT-4. . .0.5 dB (30 dB) to 3.5 dB (10 dB)
DT-8. . .0.4 dB (30 dB) to 3.3 dB (14 dB)
Manufacturer—
Cerro Communication Products
P.O. Box 2026
Anniston, Alabama 36201
(205) 831-2140

A Word From Our Sponsor

As they say in broadcast land, if you have enjoyed and profited from the preceding "feature", why not show your thanks for what you have learned by checking with the people who made this all possible; Cerro Communication Products, P.O. Box 2026, Anniston, Alabama 36201. The specifications for the CERRO DT-2, DT-4 and DT-8 directional taps are shown here. Oh yes, somebody out there is going to win free from Cerro and CATJ approximately $150.00 of Cerro DT's of your choice in this months CATJ READER CONTEST. Turn now to the contest entry card between pages 36 and 37 for your own contest entry application form!

TECHNICAL TOPICS

Earth Terminal Up-Date

Following up on the extensive CATJ report on earth terminal design and activity appearing in the October issue (Pages 19-36), the following later developments have occured.

1) Scientific Atlanta expects between **12 and 25 earth terminals will be operational by the end of 1975.** The next terminals possibly being installed as this is read, are going into Fort Smith (UA) and Laredo (UA). The next "batch" will be TelePrompter terminals at 'various locations' across the country.
2) By the middle of 1976, it is expected that **no fewer than 50 CATV earth terminals will be operational.** The majority of these, CATJ believes, will be from Scientific Atlanta, although Andrew Corporation will supply the first terminal to United Cable (formerly LVO Cable), in Tulsa.
3) The present receivers are being delivered in the "frequency agile" format, and are equipped with six crystals to allow the user to 'tune-in' anyone of six separate 3.7-4.2 GHz channels.
4) The present bird, "Westar", is being used by HBO through a sub-leasing arrangement with RCA who is in turn the leasor from the Westar people. RCA expects to **launch their own satellite** (for domestic service) **on December 11th.**
5) With the launch of the RCA bird, there will follow a 60-90 day systems check out period, after which (i.e. early to mid-March, 1976) **the HBO transmissions will move** from the Westar bird to the RCA bird.
6) At that time all of the then-existing CATV earth terminals will, on a specific date and with advance warning, **re-orient their earth terminal antennas from Westar to the RCA 'bird'**; all HBO transmissions will from that date forward come through the RCA 'bird'.
7) It is anticipated that these antenna-reorientation changes can be done by the systems themselves, without any supplier assistance. The azimuth change will be a matter of "a few degrees".
8) At the present time there are reportedly only 'infrequent' video users of the Westar satellite, other than HBO. This means that while the terminal receivers going in **are equipped** for five channels **other than** the HBO 'channel', that a system that turns the knob to another 'channel' is not likely to see video; at best you will find data on the other channel(s). Systems are reminded, none the less, that the **legal responsibility** for interception of any transmissions (including HBO signals) **rests with the receiver operator;** and that inadvertent (or purposeful) CATV terminal reception of signals other than HBO, and their subsequent display on a CATV system constitutes a major violation of FCC rules.

Finally, systems are urged to institute an immediate training program for system techs to teach terminal-responsible-techs charged with keeping the terminal functioning how to spot likely signal outage **sources.** An HBO signal not received at the CATV terminal could well mean terminal malfunction; but it could **also** mean a failure of the satellite, failure of the New York RCA to Westar transmitter, failure of the HBO to RCA feed, and so on. Scientific Atlanta is suggesting the **first step** any tech takes is to telephone another CATV terminal-equipped system to learn if they are experiencing the same problem at the same time. Obviously, if they are not having problems, the problem **can be** pinpointed to the discrete terminal serving your own system(s).

ABC FEARS SAT PROLIFERATION

The friendly folks at the ABC television network have filed a Petition for Rulemaking at the FCC asking that the FCC study and devise a **national satellite communications** policy.

Forecasting wholesale mis-use of satellites and the limited frequencies available (in particular in the 4/6 GHz region where present satellite service includes CATV pay-cable feeds), ABC wants the Commission to formulate a policy today that will make available satellite service to the widest possible group of users in the future. In particular, ABC wants to be sure that if and when the networks decide the satellites are here to stay (so far they have officially ignored their presence) there will be room left to accomodate the three networks.

ABC indicated it was primarily concerned with CATV systems using earth terminals with "too broad antenna receiving beamwidths", and they wanted an FCC policy which would specify no receiving dishes of smaller than 10 meter size.

Apparently the petition was prepared prior to the ABC engineering department reading the exhaustive coverage prepared by CATJ in our October issue; because ABC repeatedly "suggested" that CATV receiving terminals were going to proliferate and "this may cost ABC and other broadcasters the opportunity to satisfy important broadcast program transmission needs in the 4/6 GHz band". ABC also noted "This (CATV proliferation) would have serious adverse effects upon the broadcasting industry over the next five to ten years and upon the public's vital interest in the widespread dissemination of information, news, public affairs, sports and entertainment programming."

Because **no pending CATV applications** have asked for dish sizes **smaller** than ten meters, the **real** reason behind the ABC request for a Rule Making Proceeding is at best disguised. It is the general belief of CATV people that ABC has engineered this Rule Making Request not so much for its fear that CATV (or other) users will **endanger** the use of multiple satellites (parked at 4 degree longitude increments), but more as a test flying of a general program to get the FCC to **halt** all domestic CATV satellite applications until the networks can marshal **their forces** against the sudden growth of CATV use of the birds.

ABC suggests that the Commission may also wish to investigate the opening of an additional satellite transmission band in the 11.7/12.2 frequency region, a region **about as desireable** now for CATV satellite program service as the 12 GHz CARS band was to the original users of the 6 GHz microwave bands in the early 60's. Some CATV people see the networks caught with their pants down, surprised by the sudden rush into satellite program delivery by CATV. Because the networks were not ready with their own plans for satellite useage, it appears they want all other users (**CATV in particular**) to be "frozen" by the FCC until the networks can figure out a way to do permanent damage to the CATV satellite embryo.

One CATV user of satellite program relay told CATJ, "If ABC is serious about this, and they are joined in this call for help at the FCC by the other two networks, the CATV users are going to have a new battle on their hands. I hope that the present and planned users of CATV satellite services realize just how bad a new freeze by the FCC could be for our industry, and they band together quickly to protect our present rights to satellite transmission services. It is the same old game all over again; CATV starts to find some hope on the horizon and the networks immediately set out to shoot us down."

MORE NOISE SOURCES

In the October CATJ, you suggested to Mr. Cordes that he track down the May/June 74 issues of CATJ for a discussion of methods utilized in locating electrical noise interference. May I also suggest that he look up the September 1973 issue of **Radio Electronics** magazine for an article entitled Corona Discharge written by Jack Darr (pages 73-78).

Steven J. Petersen,
Field Engineer
Texas Community Antennas
Tyler, Texas

Steven:

We have more requests for information on locating RFI sources than perhaps any other field-problem subject. Perhaps we will be forced to update the original May-June 74 material this coming year since those issues of CATJ are so difficult to find anymore.

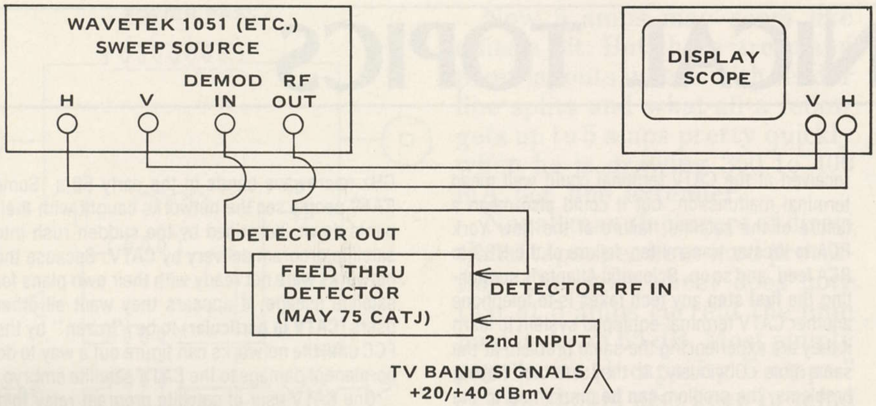
Checking Sweep Markers

Most CATV sweep generators have built-it markers at some combination of 1, 10 and 50 MHz redundancy. On occasion you have reason to suspect that your markers may be off a bit, or just to satisfy your own fears you want to check the integrity of the markers.

Most CATV sweeps also have an external marker drive jack, to couple in an external signal generator for marking applications. However, most external marker drive input ports require upwards of 0.1 volts (often measured across 50 ohms) for a reasonable marker display. Then you have the problem of **calibrating** the **external** marker source, which naturally leads to having to drive a frequency counter with the external marker/signal (RF) generator.

There **is** another way to do the job, using something everyone has convenient, the off-air or off-system TV signals.

If you employ a feed-thru detector such as that shown on pages 37-39 of the May 1975 CATJ, you have all that you need to directly compare

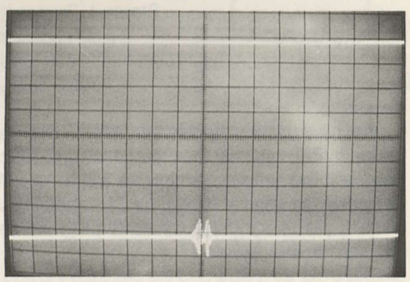


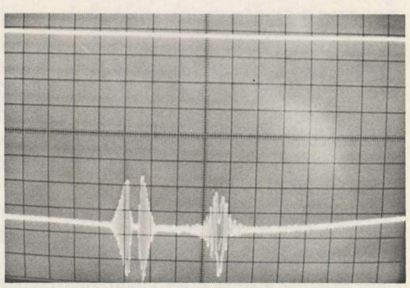
your off-air or off-cable signals with your 1 (etc.) MHz markers.

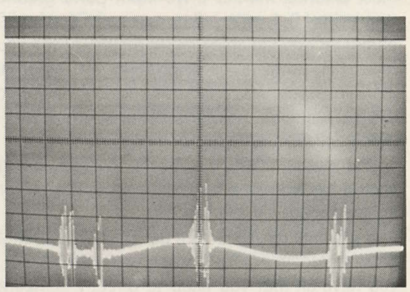
See diagram one. The feed-thru detector is inserted into the sweep/detector/scope display system so that the feed-thru detector can be driven simultaneously by the sweep output from the sweeper, and the off-air or off-cable TV signals. If your TV signal level is in the +10 to +20 dBmV region, you will have more than adequate TV carrier "marker drive" to make the display show the presence of the TV carriers. If you want a more prominent display, stick a broadband amplifier into the line between the TV signal source and the feed-thru detector input for the TV signal markers and hit the feed-thru detector in the +40 to +50 dBmV region.

In the first photo here, the Wavetek 1051 sweep's internal 50 MHz marker is shown at 200 MHz.

In the next photo we see a 199.25 MHz channel 11 video carrier introduced into the sweep through the lash-up shown in diagram







one, along with the 200 MHz internal marker (TV carrier to left).

In photo three the Wavetek 1051 internal 1 MHz markers have been added to produce internal markers every 1 MHz; note the TV carrier marker nestles in just above the 199 MHz internal and the 200 MHz internal.

The uneven appearance to the base line is caused by the detector in the system detecting video modulation along with the carrier.

Vacilating Pole Prices

On page 39 of the November CATJ, a table appeared quoting from "quotations received by CATA/CATJ" various pole supplier prices from throughout the United States. One of these suppliers has advised us that his pole prices were "in error"; in particular, "Class Poles".

Under the entry line "Maryland", change the prices as shown here:

	25'/C6	25'/C7	30'/C6	30'/C7
November CATJ	$23.95	$21.76	$31.36	$27.13
New Price	$30.12	$27.02	$39.68	$34.31

Whether "non-class-poles" from Maryland have also "gone up" is not known at this time.

Little Rooms

I think your editorial in the October issue of CATJ was very impressive. I wholeheartedly agree with your statement that the dangers are not collectively perceived. However, in my own case, I can see two or three of the "rooms" that you mention. For instance, not only am I well aware what is happening in CATV but locally we have the problem of the Environmental Protection Agency threatening to shut down the Kennecott Copper Corporation smelter. The direct result of this action would be the permanent loss of some 1200 jobs with many more jobs disappearing as an indirect result.

If available I would like about 50 reprints of this CATA-torial with permission to send copies to, among others, several newspapers, to be used "as is with credits to CATJ" as a basis for their own editorials. Keep up the good work!

Max L. McLarty
Hurley Cable TV, Inc.
Bayard, New Mexico

Max:

Copies sent along with permission to republish as they may do some good. We are all in this one together, like it or not!

"F" VIDEO FITTING

Recently one of our installers mistakenly connected a CATV drop cable to what had the appearance of being a 75 ohm antenna "F" fitting on the back of a Hitachi Color TV receiver (model C32562-CO). It was a normal assumption to make. The receiver had an "F" fitting on the apron, and many receivers now have 75 ohm "F" series fittings in that location to facilitate cable connection.

Only it turned out in this case this is a video fitting. It is not likely that this mistake will be repeated by personnel of Cablevision, S.A. because the word has been passed. However, I feel the rest of the industry should be alerted and I would like to question the wisdom of the TV receiver manufacturer sticking a non RF input F fitting on the rear of the receiver. It has been my experience through the years that video fittings are not "F" series fittings. In quality equipment, video fittings are typically BNC fittings.

This was a costly and embarrassing mistake for our system. The owner of the receiver was extremely unhappy with the results.

Ken Helms
GTE Sylvania, Sr. Field Rep.
Cablevision, S.A.
Mexico City, D.F.

Ken:

If we read you right, the F fitting on the back apron of the Hitachi receiver had live video and voltages present. Perhaps other readers can advise us of other similarly equipped recievers, imported or U.S. made. We will publish this information here in CATJ as a warning to all CATV technicians.

More October Editorial

I read and enjoyed the October CATA-torial concerning our bureaucratic world; and have shown it to our local newspaper editor. May we have permission for him to reprint it?

Terrence P. O'Connell
Com-Tel, Inc.
Menomonee, Wisc. 54751

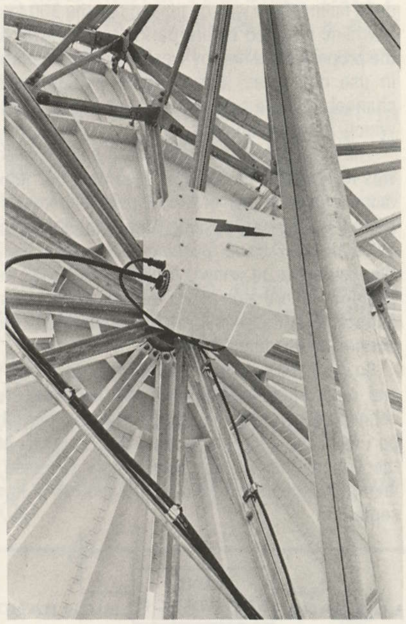
Permission granted to you and the many others who have asked for permission to reprint 'Tip, Tipping, Tipped'. For our own files, we would appreciate a copy of any use of this editorial; simply because it makes us feel better about the world we live in to see such distribution of such material!

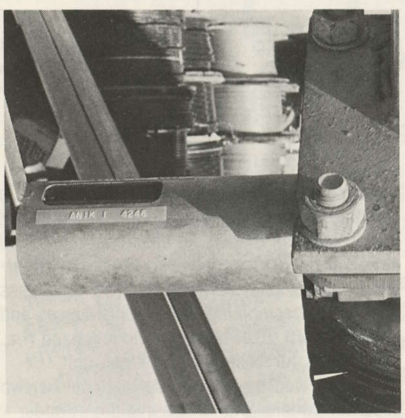
SatTerm In Tulsa

The first Andrew Corporation CATV satellite earth terminal is now operational in the Tulsa Cable TV (Tulsa, Oklahoma) system. Attendees to the Mid America CATV meeting late in October toured the Tulsa facility and saw the impressive 10 meter dish installation.

The main difference between the Andrew CATV earth terminal package, and the Scientific Atlanta package (see CATJ for October, pages 21-36) that is immediately apparent to the casual observer is the use of a Cassegrain-type feed on the Andrew dish.

The Tulsa installation is directly behind the CATV system's main office building and combination headend and local production studio. Stumbling across a 10 meter dish tucked away in a





corner of a parking lot amidst partially used reels of CATV aluminum cable is unnerving at best!

In photo one we see the installed dish assembly (Bud Desmond of Times Wire quipped that "**if you could find the other half of the set you would have the world's largest set of falsies!**").

In photo two we have the electronics for the system housed behind the dish. Coaxial line coming out is 7/8 inch while the second cable is for powering.

In nosing around CATJ found that the jack-screws (they adjust the azimuth and elevation for the dish) were marked with adjustment-counter-numbers for **both** Westar (the HBO bird) **and** the Canadian Anik 1 bird (see photo three). Now fellows, you **know** that as much as you would like to show Canadian TV on your system in Tulsa that interception of the Anik-1 signals is a no-no!

How Much Phase Shift?

Recently the CATV industry has begun to show more and more concern about the amount of phase shift contributed to a processed signal by any and all active (and some filter-passive) CATV headend equipment.

Measuring phase shift, and, measuring passband delay and delay distortion, becomes increasingly important as CATV processing equipment moves into the "studio-monitor-quality" era. Any undue amounts of phase shift and/or passband delay (with delay distortion) contributes to the overall "smeared" quality of a CATV signal on a plant.

For a couple of years many heterodyne signal processor manufacturers have been supplying, upon request, certain phase shift and delay measurements for their processing units. However, to the best of our knowledge other headend equipment-type suppliers have not found the time to perform these measurements or to provide the data.

Because phase shift and passband delay **can be** cumulative, the total additive effects of several units all contributing incremental amounts of one or both to the received signal should be considered by any system engineer or technician charged with keeping the video signals looking crisp and sharp.

Recently **CATJ** asked Hansel Mead at the Q-BIT Corporation (Melbourne, Florida) to provide us with this data on their SX-0500 series of single channel, low noise signal pre-amplifiers.

In Diagram 1 we see that the gain product remains plus/minus a few tenths of a dB throughout the visual carrier region; dropping by approximately 0.25 dB at the aural carrier. The phase shift, with the 6 MHz TV channel frequency center measured as "zero shift" varies from +37 degrees at visual carrier to —37 degrees at color sub-carrier.

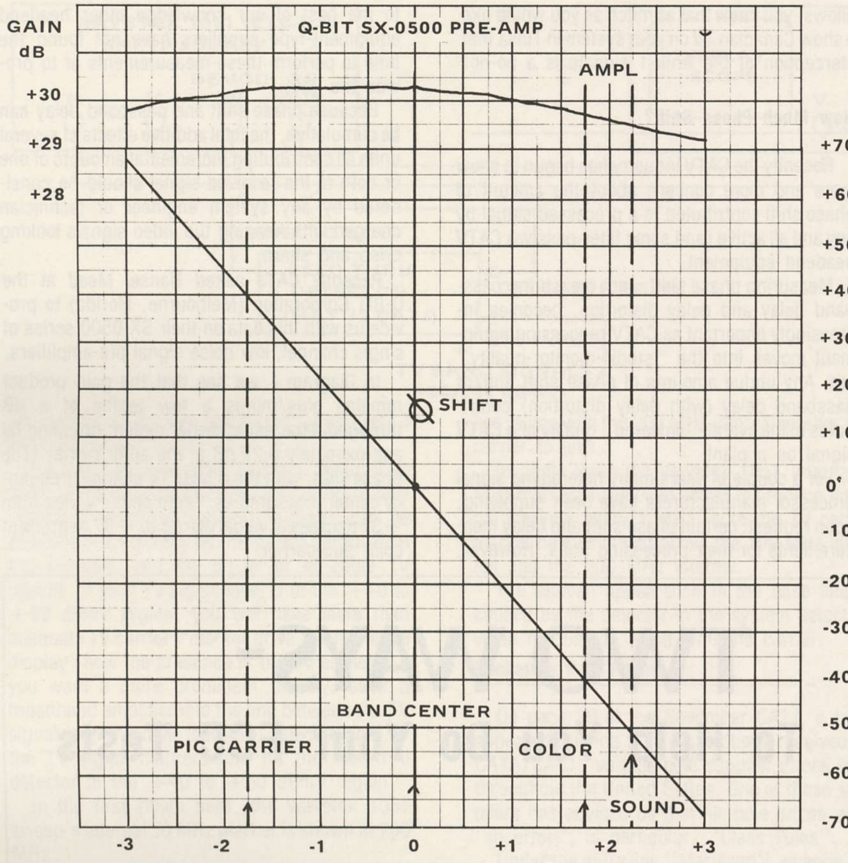


DIAGRAM ONE

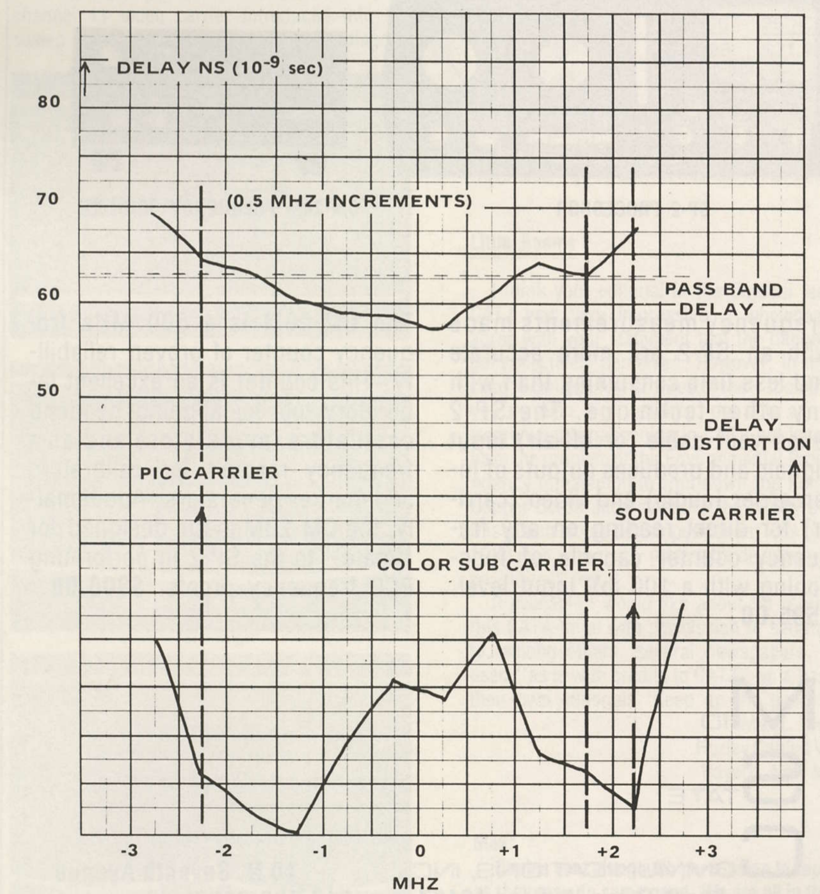


DIAGRAM TWO

In Diagram 2 we see that delay in nanoseconds varies from 63 ns at the picture carrier frequency to a low of 57.5 ns at the mid-channel region, to 63 ns again at the color region. The amount of delay distortion, also shown in Diagram 2, is between 0 (base line) and .081.

CATJ welcomes similar measurements from other headend equipment suppliers; they will be afforded "equal time" in our **Technical Topics** column.

Doubling Up Downlines

Recently at the CATJ Lab we were faced with a late afternoon decision. A new antenna system in our multi-mode project was installed, but with dusk falling there was no time to run the 300 foot downline required before dark. On the tower at the proper height nearby were a pair of existing, in use downlines, one carrying a high band channel and one carrying a low band channel. Which gave us an idea.

The multi-mode antenna we had just installed was for channel 12. Digging around in our junk box we found a pair of hi-low band separators. Neither were power passing (**question:** does anyone make a DC power passing hi-low separator? We would like to know!) which meant that we couldn't run pre-amp power through them; but in our special situation all pre-amplification is at the bottom of the line anyhow.

So we installed one at the top (see diagram 1) and one at the bottom. Into the low port we connected the channel 2 signal, and into the high port went the multi-mode channel 12 signal. At the bottom the process was simply reversed; taking channel 2 and 12 out with another hi-low separator.

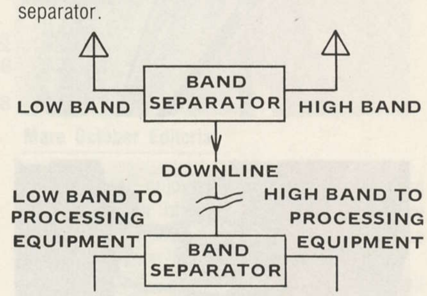


DIAGRAM ONE

We could have installed hybrid splitters (as a **combiner** at the top, and as a traditional **splitter** at the bottom) but that would have cost us around 4-5 dB of signal loss. However, the hi-low separation devices **total** between the two units less than a dB of combining (separating) losses and provide 30-40 dB of high band to low band (i.e. 12 to 2 in our case) isolation per unit.

This allowed us to use one feedline for two separate signals, with only a minimum (under 1 dB) combining and separating losses. Band separators can be designed for virtually any frequency range (i.e. run 2-4 on one leg, 5-6 on another leg, etc.) so the approach should be repeatable for many different applications. If you can locate a power passing (DC if you have DC supplied pre-amps, AC if your pre-amps are AC supplied), you could run pre-amplifiers are each leg independently. We see no AC supplied), you could run pre-amplifiers for each leg independently. We see no reason why many downlines cannot be eliminated from many towers using this approach; with the attendant reduction in tower downline capital costs and tower vertical loading from the weight factor reflecting fewer downlines on the tower.

MICROWAVE COOPERATIVES FORM BASIS FOR EXPANDED PROGRAM SERVICES

CATV systems, especially those in the western USA, have always been heavy users of microwave. Therefore CATV use of microwave is not a new phenomenon. In fact, it is more than 20 years old!

Still, *there is* new interest in CATV microwave, and it is coming from several regions of the country, for as many varied reasons as systems are interested.

Each time the FCC effectuates some re-defining of CATV signal carriage rules, either relaxing or tightening (and that is usually a subjective point of view for each operator), new opportunities for some form of microwaved signal carriage appear on the "horizon". Currently, there is real *new interest* in terrestrial microwave delivery of *satellite delivered pay television programs*, as one example.

CATJ's current expanded coverage of the satellite "package" would not be complete without some investigation of the terrestrial inter-connections possible for prospective users of the satellite delivery medium. Certainly there are but a handful of *individual systems* which, alone, can financially justify the considerable expense of installing an earth terminal receiving system for satellite program delivery. And with the possible exception of a few highly *concentrated* west coast areas (i.e. San Francisco Bay region) and sections of Pennsylvania, most CATV systems "stand alone" without the present immediate ability to trunk-link via terrestrial cable *from one system to another.*

Therefore if *one* system is affluent enough, and large enough, to afford the initial and on-going investment in an earth terminal, inter-connection of the earth terminal received signal to nearby, surrounding CATV systems is usually not practical or possible via coaxial

By
Norman Woods, Manager Marketing Services—AML Theta-Com of Phoenix Subsidiary of Hughes Aircraft Co.

link-age.

So the microwave portion of the link becomes increasingly important for the CATV system operator interested in forming a cooperative pool with his fellow, nearby system operators. The concept of CATV systems working together, financially and technically, is not a new one, in the microwave arena. Many existing CARS band installations are jointly owned and operated, under the applicable provisions of the FCC rules that permits such sharing of expenses on a non-profit basis.

This report is intended to illustrate how *such a microwave cooperative effort* can be put together, and the advantages to be derived from such a joint effort. A later report in a future issue of *CATJ* will explore the legal ramifications and guidelines required by the FCC for such joint-pooling of efforts and finances. A third and final portion of this three part series will investigate the technical problems associated with such a project, and provide you with guidance in the area of preparing your own operator-joint-effort engineering studies that would be preliminary to actually going to an equipment supplier or suppliers for equipment and package quotations.

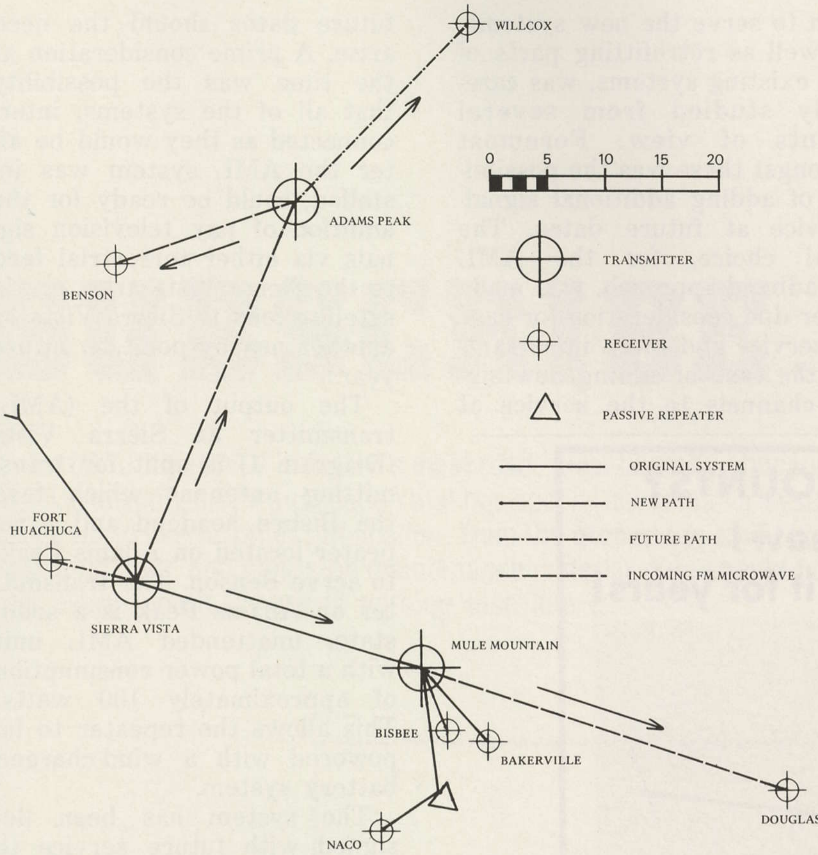
Distant Signals To Southern Arizona

Three CATV systems operating in the southern Arizona area shared a common problem; finding a means of transporting distant independent (non-network) station signals over approximately a 100 mile path. The three systems, Chaparral Cable Television of Benson, Douglas TV of Douglas and Bisbee CATV of Bisbee determined early on that if *any* of the three systems were to get the elusive independent signal into their towns, it would be only as a result of a cooperative venture. Therefore *Southern Arizona Cable Cooperative* was formed and the wheels set into motion.

A neighboring system, Sierra Vista CATV in Sierra Vista, Arizona already owned a two-hop private microwave system bringing desired signals to the Sierra Vista headend. Therefore, with the signals in the general vicinity, and available from Sierra Vista at its headend, this seemed like a logical place to start (see Diagram 1).

Each of the initial participating systems had a variety of reasons for wanting to become a part of the proposed program. One system, located less than an hour's drive from the Tucson stations, knew that his potential customers were already receiving good to excellent quality network service via Tucson. A Tucson independent station was received with a lower grade of signal; but in this situation even if the Tucson independent was received well, the programming of the station leaves much to be desired when the programming of the potential independent from Phoenix was available *as a comparison.*

All of the systems felt delivery of *both independent signals*, one from Tucson and one from Phoenix, was an impor-



tant addition to their systems. A system already carrying both signals felt it wanted to be *a part of the program* simply because the microwave delivery of both independent signals promised *much higher grade signal levels* to his customers than he was experiencing with distant off-the-air pick up and subsequent cabling.

CARS Band Rules

In formulating the CARS Band (Community Antenna Relay Service) rules, the Federal Communications Commission anticipated that CATV operators, especially smaller systems in more remote areas, would join together to make shared use of the microwave service. The Commission fully expected, and made rule-allowance for, systems to share capital expenditure and analyzed operating costs on a cooperative, yet mutually beneficial arrangement. And, the Commission allows a considerable degree of latitude as to how these costs can be divided.

The instant case of the Southern Arizona Cable Cooperative illustrates. Systems initially participating in the program vary in size from 400 to 4,000 subscribers. If costs were shared equally, 1/3rd for each system, the 400 subscriber system would find his share prohibitive when weighed with his potential returns. On the other side of the coin, if costs were shared *strictly* on the basis of the number of subscribers per system, the larger system would be paying considerably more money (10 times as much) for essentially *the same service* as the 400 subscriber system.

The final solution for the Southern Arizona Cable Cooperative was a program whereby after carefully planning equipment needs, it was determined that each system would initially pay for *only* that portion of the equipment which was utilized to serve its own system.

Equipment Integration

Two of the involved system operators already had microwave equipment. The two-hop microwave system serving the Sierra Vista system was a classical FM system where signals are transmitted channel by channel; one set of equipment per channel. The Bisbee system, on the other hand, was utilizing the Theta-Com broadband AML equipment. Expansion to serve the new systems, as well as retrofitting parts of the existing systems, was carefully studied from several points of view. Foremost amongst these was the possibility of adding additional signal-service at future dates. The final choice, for the AML broadband approach, was made after due consideration for ease of service and more importantly, the ease of adding new signal-channels to the service at future dates should the need arise. A prime consideration at the time was the possibility that all of the systems, interconnected as they would be after the AML system was installed, could be ready for the addition of pay television signals via either terrestrial feed to the Sierra Vista area, or via satellite feed to Sierra Vista or another nearby point, in future years.

The output of the (AML) transmitter at Sierra Vista (Diagram 1) is split for transmitting antennas which feed the Bisbee headend and a repeater located on Adams Peak, to serve Benson. The transmitter on Adams Peak is a solid-state, unattended AML unit with a total power consumption of approximately 100 watts. This allows the repeater to be powered with a wind-charged battery system.

The system has been designed with future service to additional communities also in mind. As additional systems are built or as additional systems in the area decide they wish to be a part of the cooperative, they can be accommodated quite simply and easily through the addition of power splitters at the appropriate transmitter site, plus some waveguide and microwave transmitting antennas. As with the present initial members of the cooperative, additional systems added later on will purchase their own microwave receivers. Each additional cooperative member system will in turn reduce proportionately the investment of existing operators who have initial capital invested in their appropriate transmitting system sites.

Another aspect of the financial considerations not to be overlooked is the handling of the capital investment by each system. Because the equipment supplier was able to fund the system over a *six year payout period,* the actual initial capital cost is being spread according-

David Henkel (left), President of Chaparral Cable Television (Benson) and Abe Sonnenschein, director of engineering for Theta-Com inspect one of the AML units for the Southern Arizona Cable Cooperative. AML, incidentally is now serving more than 100 CATV systems throughout the United States.

ly. This affords each system the opportunity to handle this depreciation, investment tax credits and interest expenses in a way which is often highly advantageous; especially to an older, established system.

Stable Penetration

Of particular interest to older, established systems with an almost zero growth rate due to high penetrations that have come with time, is the possibility that as a joint effort the systems can now look at the various forms of pay or premium television available.

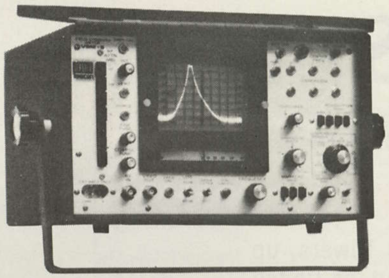
Individually, even the system with approximately 4,000 subscribers is by itself a borderline situation for pay or premium television service. Not only are most pay-program-packagers less than *anxious* to talk with such (relatively) small systems, but the expense of equipping for the additional programming is considerable.

Between the six systems now involved directly or indirectly in the program, there are approximately 10,000 subscribers. And while even that number is not on a par with many eastern and California systems now engaged in the pay aspects of cable operation, it is far better than the individual systems alone could muster. This becomes especially true of the smaller-system-members of the cooperative, where a 400 subscriber system would *never* be able to get involved in the *present* level of pay operation.

Consequently the cooperative is now investigating two different approaches to expanding into pay operation. One is to simply lease a channel to a premium television operator, and leave the marketing and programming entirely in his hands. The alternate approach is for the cooperative to work as a single body representing approximately 10,000 subscribers and to enter the pay television arena just as it entered

the microwave delivery arena, *on a cooperative basis.*

As Dave Henkel, Co-Op President (Chaparral Cable TV, Benson) notes, "This whole program has already proved beneficial to all of the parties involved. It enabled us to get the signal from Sierra Vista on a cost-shared basis for the two independent stations for our subscribers, and now for the for the first time the door is open for us to investigate the possibilities of bringing pay cable services to Southern Arizona."



cata ASSOCIATE MEMBER ROSTER

In recognition of the untiring support given to the nation's CATV operators, and their never-ending quest for advancement of the CATV art, the COMMUNITY ANTENNA TELEVISION ASSOCIATION recognizes with gratitude the efforts of the following equipment and service suppliers to the cable television industry, who have been accorded ASSOCIATE MEMBER STATUS in CATA, INC. for 1975.

Anixter-Pruzan, Inc., 1963 First Ave. S., Seattle, WA. 98134 (**D1**)
Avantek, Inc., 3175 Bowers Avenue, Santa Clara, CA. 95051 (**M8**)
Belden Corp., Electronic Division, Box 1327, Richmond, IN. 47374 (**M3**)
BROADBAND ENGINEERING, INC., 850 Old Dixie Highway Lake Park, FL. 33403 (**D9, replacement parts**)
Burnup & Sims, Box 2431, W. Palm Beach, FL. 33401 (**S2, S7, S8**)
Cable Dynamics Inc., 501 Forbes Blvd., So. San Francisco, CA. 94080 (**S8, equipment repair**)
CABLE NEWS, 2828 N. 36th Street, Phoenix, AZ. 85008 (**S6**)
Cerro Communication Products, Halls Mill Road, Freehold, NJ. 07729 (**M3, M5, M7**)
COMM/SCOPE COMPANY, P.O. Box 2406, Hickory, NC. 28601 (**M3**)
DELTA BENCO CASCADE INC., 40 Comet Ave., Buffalo, N.Y. 14216 (**M4, M7, M8, D3, S8**)
Jerry Conn & Associates, 550 Cleveland Ave., Chambersburg, PA. 17201 (**D3, D5, D6, D7**)
C-COR ELECTRONICS, Inc., 60 Decibel Rd., State College, PA. 16801 (**M1**)
DAVCO, Inc., P.O. Box 861, Batesville, AR. 72501 (**D1, S1, S2, S8**)
DEVINES Trailers & Accessories, Grantville, PA. 17028 (**M9, cable trailers**)
ENTRON, Inc., 70-31 84th Street, Glendale, NY. 11227 (**M4, M5, D4, D5, S8**)
GAMCO INDUSTRIES, INC., 317 Cox St., Roselle, NJ. 07203 (**M5**)
JERROLD Electronics Corp., 200 Witmer Road, Horsham, PA. 19044 (**M1, M2, M4, M5, M6, M7, D3, D8, S1, S2, S3, S8**)
Kay Elemetrics Corp., 12 Maple Avenue, Pine Brook, NJ. 07058 (**M8**)
Microwave Filter Co., 6743 Kinne St., Box 103, E. Syracuse, NY. 13057 (**M5, bandpass filters**)
MID STATE Communications, Inc., P.O. Box 203, Beech Grove, IN. 46107 (**M8**)
Pro-Com Electronics, P.O. Box 427, Poughkeepsie, NY. 12601 (**M5**)
QE Manufacturing Co., Box 227, New Berlin, PA., 17855 (**M9, tools & equipment**)
RMS CATV Division, 50 Antin Place, Bronx, NY. 10462 (**M5, M7**)
Sadelco, Inc., 299 Park Avenue, Weehawken, N.J. 07087 (**M8**)
Systems Wire and Cable, Inc., P.O. Box 21007, Phoenix, Az. 85036 (**M3**)
TEXSCAN Corp., 2446 N. Shadeland Ave., Indianapolis, IN. 46219 (**M8, bandpass filters**)
Theta-Com, P.O. Box 9728, Phoenix, AZ. 85068 (**M1, M4, M5, M7, M8, S1, S2, S3, S8, AML Microwave**)
TIMES WIRE & CABLE CO., 358 Hall Avenue, Wallingford, CT. 06492 (**M3**)
Tocom, Inc., P.O. Box 47066, Dallas, Texas 75247 (**M1, M4, M5, Converters**)
TONER Cable Equipment, Inc., 418 Caredean Drive, Horsham, PA. 19044 (**D2, D3, D4, D5, D6, D7**)
Van Ladder, Inc., P.O. Box 709, Spencer, Iowa 51301 (**M9, automated ladder equipment**)
WAVETEK Indiana, 66 N. First Ave., Beech Grove, IN. 46107 (**M8**)
Western Communication Service, Box 347, San Angelo, Texas 76901 (**M2, Towers**)

NOTE: Associates listed in bold face are Charter Members.

Distributors:

D1—Full CATV equipment line
D2—CATV antennas
D3—CATV cable
D4—CATV amplifiers
D5—CATV passives
D6—CATV hardware
D7—CATV connectors
D8—CATV test equipment

Manufacturers:

M1—Full CATV equipment line
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M7—CATV connectors
M8—CATV test equipment

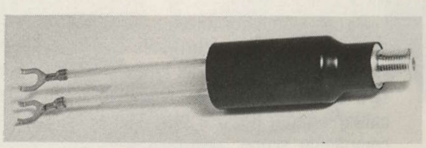
Service Firms:

S1—CATV contracting
S2—CATV construction
S3—CATV financing
S4—CATV software
S5—CATV billing services
S6—CATV publishing
S7—CATV drop installation
S8—CATV engineering

HI-PASS COMBO UNIT

RMS Electronics, Inc. (50 Antin Place, Bronx, New York 10462) has announced their model CA2600F which combines the functions of a hi-pass filter and a matching transformer into a single integrated unit.

The unit blocks signals below 50 MHz (attenuation 28 dB minimum from 5-25 MHz) to keep two-way, amateur, citizens band and other lower frequency users from getting into the cable receiver at the 300 ohm antenna terminals. The unit is also appropriately utilized for 2-way CATV systems carrying signals below 50 MHz.

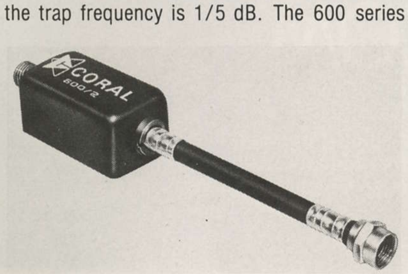


The forward pass region is 50-300 MHz with a typical insertion loss of 0.7 dB. The unit has all of the appearances of a typical back of set matching transformer. Full information is available directly from RMS.

CORAL PAY TRAP

Coral, Inc. (400 Ninth Street, Hoboken, N.J. 07030 / 201-792-6306) has introduced their own version of the pay cable subscriber trap.

The trap inserts into the drop line at the directional tap (or pressure tap) with an integral short length of RG-59/U (part of the trap assembly). Insertion loss from 5 to 300 MHz is speced at 0.2 dB while the thru loss +/— 6 MHz from the trap frequency is 1/5 dB. The 600 series traps are AC/DC burn-out protected and housed in a die-cast container.



Coral has also announced a new trunk/distribution channel trap; housed in a 6 x 4.75 x 3 inch weatherproof cast aluminum housing, equipped with standard 3/4 inch fittings. The unit is RF shielded with a 12 amp power passing capability. Full information on both units is available from Coral.

NEW DELUXE VAN LADDER

Van Ladder, Inc. (P.O. Box 709, Spencer, Iowa 51301) has announced a new "deluxe version", the TS2515-D multi-purpose unit.

The TS2515-D offers a roof mounted catwalk entry and exit to the bucket, a 29' working height with 15' reach from the vehicle in all directions, a separate 6' in/out function, a splicer/sweep bucket with built-in covered tool box, provisions for inter-comm and/or 2-way radio controls in the bucket, air and AC in the bucket, storage racks, strobe light, a 350 pound bucket rating; all standard equipment.

The unit's low weight allows it to be mounted

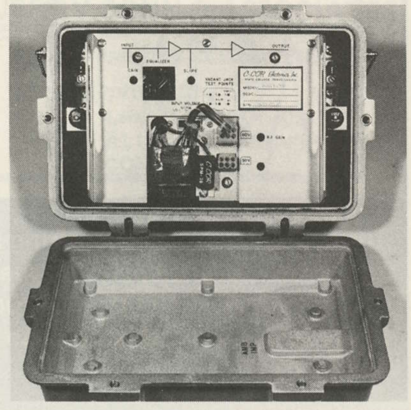
on any ½ ton or larger van or truck with only minor vehicle modifications. Full details of the lease program for this unit (approximately $185.00 per month) are available from the manufacturer.

COOL LINE EXTENDER

C-COR Electronics, Inc. (60 Decibel Road, State College, Pa. 16801) has developed a new family of plant amplifiers which feature extremely low operating temperatures, thereby contributing to lower unit heat and improved field operating reliability.

The model D442-2MR amplifier (shown) has 40-300 MHz operating characteristics. Options available include 28 or 42 dB gain, with two hybrids for mini-trunk or distribution amplifier applications; 28 dB gain with a single hybrid for line extender amplifier applications; two-way filters; reverse amplifier; level control by manual, plug-in thermal or composite video (automatic); powering voltages of 30 or 60 VAC, 115 or 230 VAC, 50 to 60 Hz; plug-in fixed or thermal bandwidth limiting equalizers with equalization for bandwidths of 220, 245, 270 or 300 MHz; and the C-COR SPM (surge protection) module.

The temperature rise is less than 13 degrees C between hybrid flange and the outside ambient air temperature.

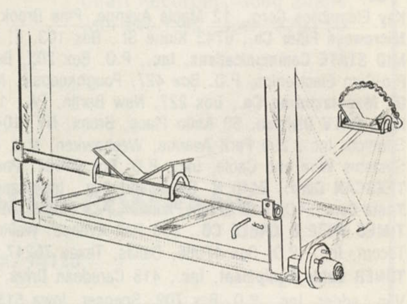


POLE CARRIER

Devines Trailers and Accessories (P.O. 29, Grantville, Pa. 17028 / 717-469-0777) has a new option for their cable reel trailers that is extremely timely in view of new interest in pole setting by CATV systems.

''Option L'' is a pole carrier that quickly and easily adds on to the existing (Devines) reel trailer; and does not interfere with the primary function of loading reels from the ground without the requirement of an external reel lifting device.

A special price of $149.75 for Option L is good through December 31, 1975. Not shown, but included is a compantion pole muzzle.



CONVERTERS TO JACKSON HOLE

Jerrold Electronics Corporation recently signed a contract with Jackson Hole Telecommunications, Inc. (Wyoming) to provide the remote Wyoming system with 2,000 Jerrold set converters. The converters (30 channel) will be utilized throughout Jackson, Teton Village, Racquet Club, Skyline Ranch and South Part.

Concurrently, the older Jerrold system (service began in 1957) has been rebuilt with Starline 20/300 equipment.

PORTA-BRIDGE II

Sadelco, Inc. (299 Park Avenue, Weehawken, N.J. 07087) is now delivering a new broadband 75 ohm wideband noise source; the Porta-Bridge II.

By combining the unit with any SLM/FSM, the operator can make return-loss and VSWR measurements on virtually all types of 75 ohm passive devices or active components (including cable) without the use of a sweep system and companion scope.

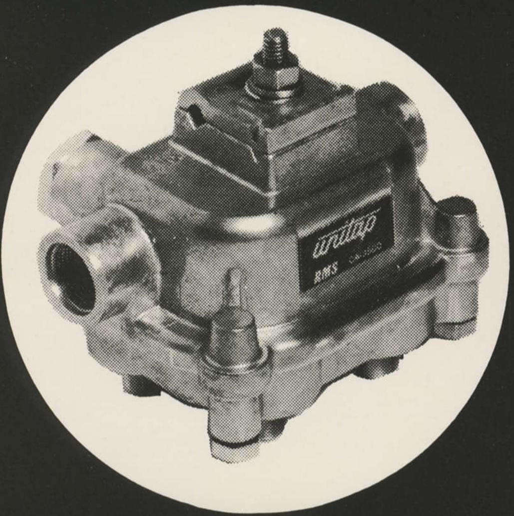
Porta-Bridge II is battery powered and the bridge terminal assembly has been contoured to fit into tight places for greater field utility.

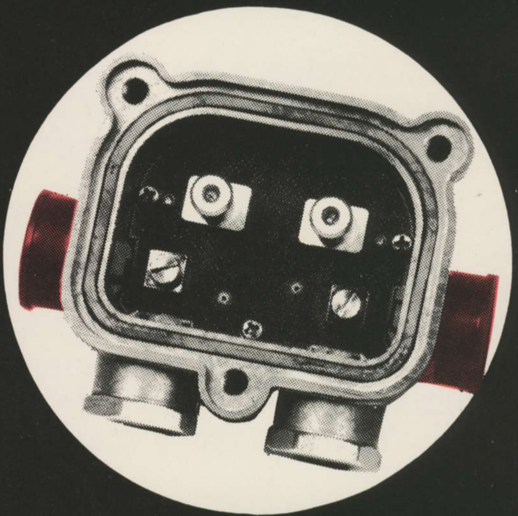
unitap™

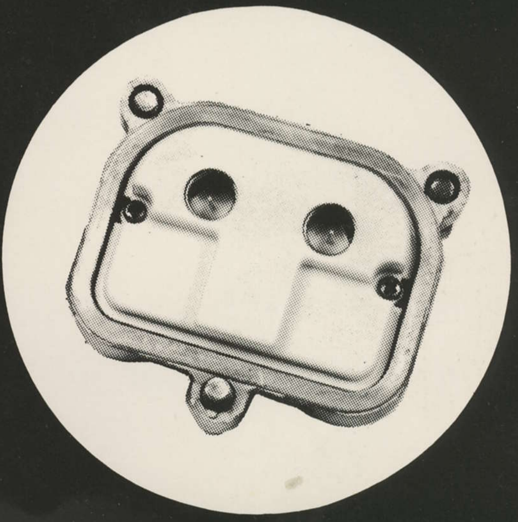
A major new innovation in directional tap design

1. Featuring interchangeable bottom plate design, the two way and four way bottom tap plates easily interchange with one another.
2. Most of the 23 major features designed into the Unitap™ are not found in competitive taps.
3. The Unitap™ features a lower insertion loss, tap for tap, than other competitive units.
4. Unitap™ is by far the most advanced product of its kind. Get the full details today... write or call us collect.

RMS CATV DIVISION
ELECTRONICS, INC.







RMS ELECTRONICS, INC. 50 ANTIN PL., BRONX, N.Y., 10462/CALL COLLECT (212)892-1000/TELEX #224652- 24 HOUR SERVICE/CABLE ADDRESS "RAMONICS".
CANADIAN REPRESENTATIVES: DESKIN SALES CORP. / MEXICAN REPRESENTATIVES: TV CABLE DE PROVINCIA S. A., MEXICO CITY, MEXICO.
WORLDWIDE EXPORTS - INCLUDING PUERTO RICO - ROBURN AGENCIES INC./CABLE ADDRESS: "ROBURNAGE"/NEW YORK TELEX #23574 "ROBR-UR".

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COLUMBUS, OHIO 43227

614/236-8683

July 25, 1975

Gary J. Balsam, Executive Vice President
Gamco Industries Inc.
317 Cox Street
Roselle, New Jersey 07203

Dear Gary:

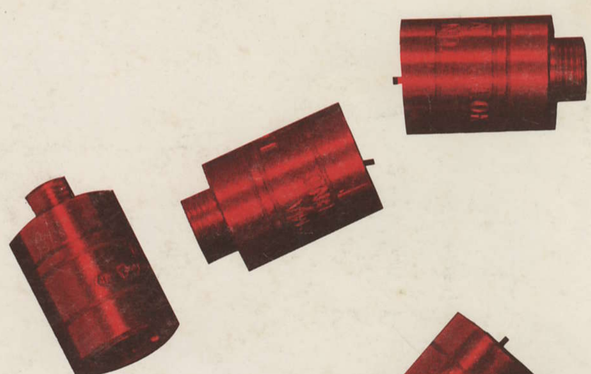
I have never written a letter like this before, but I think it is appropriate to let you know that your Terma-Lok B.M.T.-75 ALHS terminators are just about the greatest thing I have ever used.

Our Columbus System has over 27,000 customers with approximately 10,000 of these customers being in apartments. We are in the process of audit on these apartments, and using Terma-Lok on all non-used taps. To date we have found over 400 bandits in less than 2,000 units. Our recovery rate has been approximately 70% of these bandits to paying customers. This is entirely due to Terma-Lok. Terma-Lok is making us money, not costing us money.

Keep up the good products.

Yours truly,

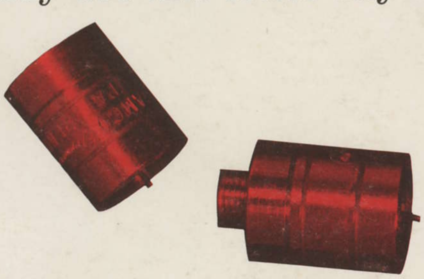
D F Neiman



David F. Neiman
Construction Manager

P.S. You may use this letter any way you see fit.

DFN:jak



GI
GAMCO
INDUSTRIES INC.

291 COX STREET, ROSELLE, NEW JERSEY 07203•(201) 241-7500•TELEX 138-005